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HYDROELECTRIC STARTING-UP EXPERIENCES.

BY LLEWELLYN EVANS.

ADVANTAGES OF HIGH VACUUM AND SUPERHEAT.

BY C. R. DELANEY.

WASTEWAYS OR ESCAPES ON CANALS.

BY B. A. ETCHEVERRY.

PURIFICATION OF GAS.

BY E. C. JONES.

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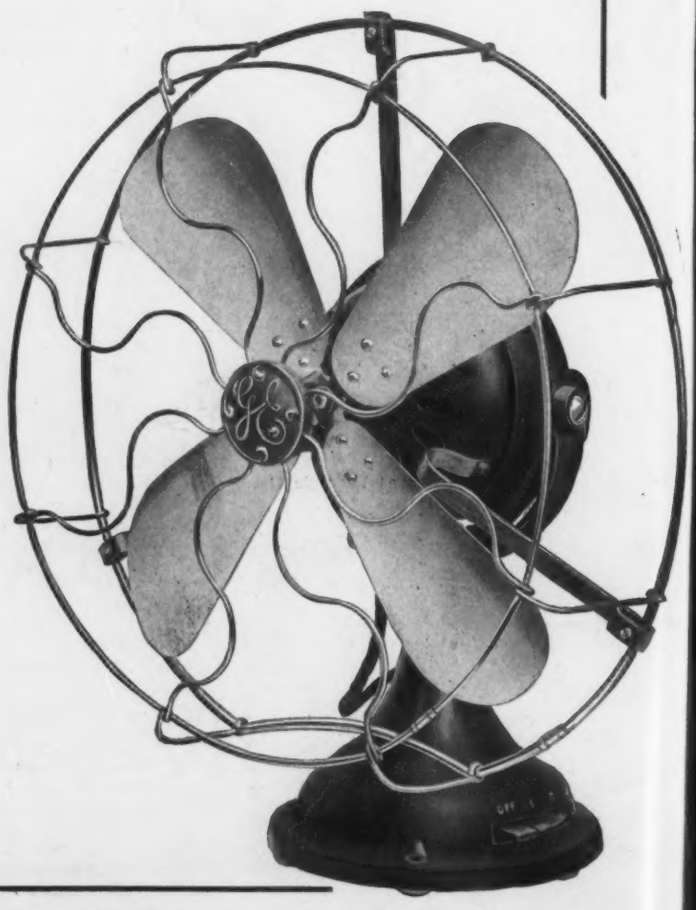

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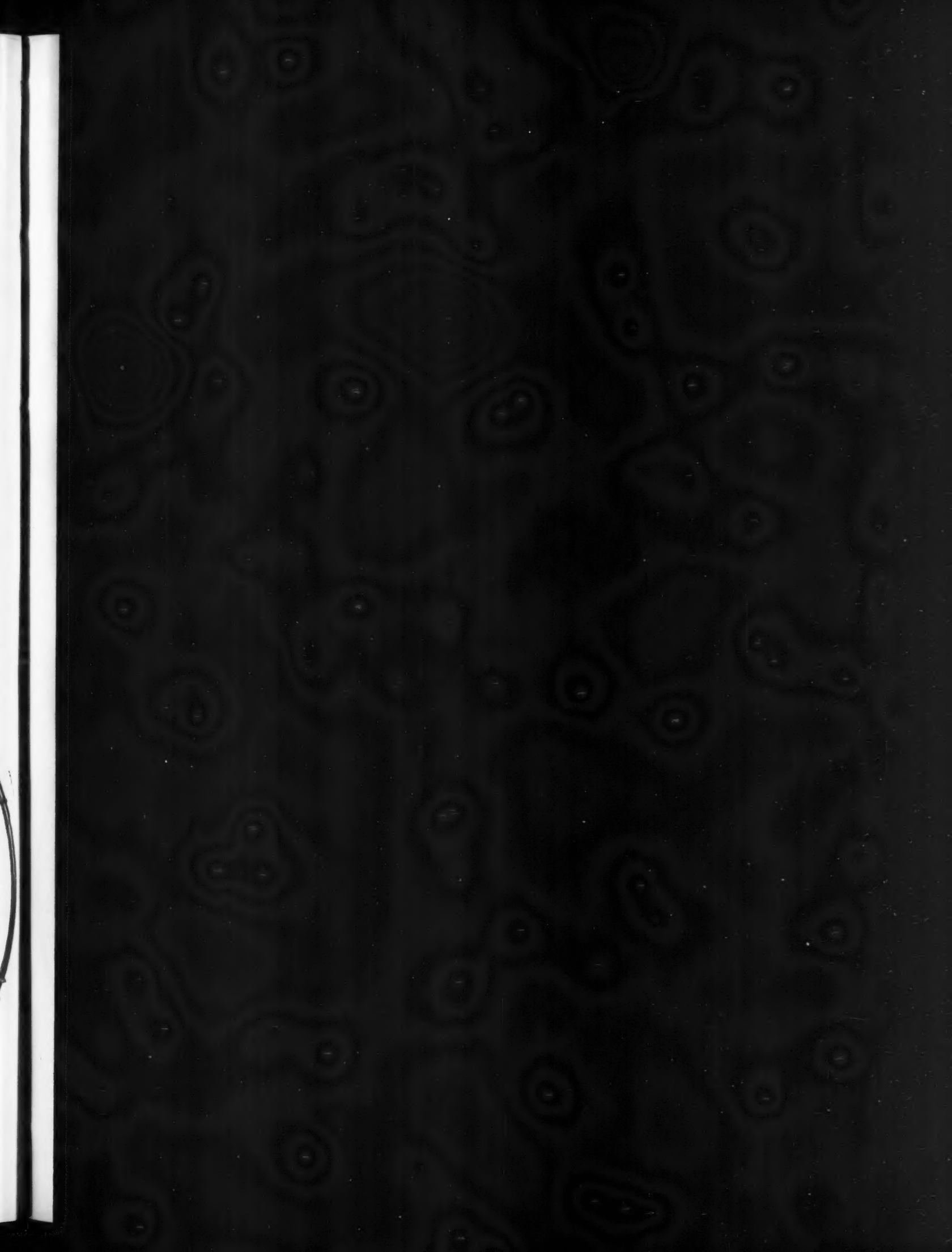

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HYDROELECTRIC STARTING-UP EXPERIENCES

BY LLEWELLYN EVANS.

"At the Power House, When the Water Was Turned in, the Tailrace Was Two-Thirds Full of Mud."

For those who have not read the article of description of the Tacoma Municipal Power Plant, appearing in the Journal of Electricity, Power and Gas of March 1, 1913, we would describe the development to consist of a diversion dam, a two-mile tunnel across a bend in the Nisqually River, a concrete reservoir, and the four penstocks dropping down into the canyon with 425 ft. head, and connected with four 5000 kw. turbine units, which supply current to be transmitted thirty miles by duplicate transmission line to Tacoma.

Gates.

The first apparatus in connection with this subject to be tried out were the ten gates about the reservoir. Two of these are for waste gates, two for bypass gates, four for forebay gates for the penstocks,

and two for wash out gates. They are all uniform in size with a six foot opening, and are made of cast iron with bronze bearings fitted water-tight. After these gates had been placed and left by the machinist in apparent working order, several weeks' work was necessary on them a few months later in cleaning the guides, screw threads and gears. While at first it was practically impossible for several men to operate the gates by hand, and impossible for the motors to move them, after all careful adjustments were made and everything cleaned up and oiled, one man could easily operate the hand levers and the motors gathered speed on the first notch.

It was found that with just a few inches of water behind them the gates leaked profusely. As soon as they were covered with sufficient water to cause some pressure there were no leaks. The gearing of the gates was designed to accommodate limit switches for disconnecting motors at the end of travel, but these switches were omitted as the installation was carried out, and it was found that the over-travel of six inches top and bottom gave sufficient time for the operator to stop the gate, and also that when the limits were over-run the progress of the motors was automatically cut out by the overload breakers.

The controllers of all but the forebay gates are hand operated. The adjustments to be made on first starting were to set the hand wheel starting lever point so that the off position was horizontal, and travel upwards raised the gates and travel downwards lowered the gates. For the temporary source of power all the motors were set to run in the same direction for the same position of the starting lever, so that when the permanent source was connected in, it was just a matter of reversing one phase to turn all the motors right side up.

The forebay gate motor controllers are solenoid operated in successive steps and form the first relay by a contact button. There were no entanglements to unsnarl, except that dirty stop-contacts caused considerable trouble in locating the fault as such, the trouble being intermittent. The small contact points were not sufficient to insure true connections and their failure came nearly proving disastrous when the first water was turned into the reservoir. It happened that the temporary telephone system between the intake and the reservoir having failed to work after the signal was given to turn water from the tunnel, and with the river full in the channel behind the spill wall the reservoir started rapidly to fill up, while all of the forebay gates were yet open and the men working in all of the pressure pipes. On failure of the motors to operate, they worked frantically on the last gate to close it by hand while the fault was being discovered, when it was but a moment's work to run the gate down by power, and the water was just trickling over the weir wall in front of the forebay pipes when the gate was swung into place. This would not have been so serious a matter had the wash out gates operated smoothly, but due to incompleted adjustments, only one could be opened a short distance, and not sufficient water could be turned into the waste channel to keep up with the in-rushing water. Such emergencies would never occur in the regular operation of the reservoir, because when everything was in working order the equipment worked smoothly. After the first water had been turned from the reservoir through the washout gates, water was admitted into the forebay compartment behind the weir wall through the by-pass tunnels under the reservoir direct from the conduit at the entrance to the reservoir, and the first water was turned into the penstocks by opening the small 12 in. by-pass valves by hand, and allowing the stream of water about four inches deep to run down the pipe and gradually fill it past one supporting pier at a time to test them. Throughout this filling process riveters and caulkers watched the pipe line for leaks. Of course no pipe line can be expected to be tight at the first trial. The leaks found, however, were not serious and were limited to sand holes in flanges, with but slight leaks in the rivets and along seams. Many of these leaks closed themselves after a week under pressure and others were easily closed with a caulking tool.

At the power house when the first water was turned in the tailrace was two-thirds full of mud and large embankments of excavated material stood up in front of the relief valve outlets. The first water turned into the turbines showed a remarkably tight job. The turbine casings would not be known to contain water. The smaller piping, unions, ells, etc., around the automatic relief valve and by-pass were not near so fortunate and this work kept the turbine crew many hours to get tight. The adjustment in clearing out the automatic relief valves was particularly a toilsome job, for the penstocks had not been cleared carefully, and overalls, rocks and scaffolding kept collecting for a week or more in the relief valves and exciter nozzles. The first water which came through the automatic relief valves soon disposed of the muck heap in front of them. When the valves were turned wide open, the 425 ft. head of water ripped down the mounds of earth as if the relief openings were giants purposely designed to do it. The tailrace muck was considerably slower in disappearing, because little water was required to turn over the turbines without a load which was not at that time available. However, all water that did pass through the tailrace contained a large percentage of silt, so that the closed area soon became a safe opening. The two main bearings of each machine ran without perceptible rise in temperature from the start; the water-cooled jackets and a self-aligning feature making this almost a certainty.

Exciters.

The exciter units were the first to be put into service and much trouble was experienced with debris lodging in the nozzles.

The governors took care of the speed in excellent style from the first, only slight adjustments for sensitiveness being made.

As the exciters were direct connected right handed and left handed to the Pelton wheels, when they were first started it was found that their compoundings were connected opposite. With insufficient load for testing it was practically impossible to determine which was compounded correctly and much needless time was lost, for as soon as a three-quarter load was obtainable the generator which was com-

pounded wrong showed a drop of about fifteen volts, while the one which was compounded correctly fell off only five or six volts on application of the same load. To straighten out the compounding it was necessary to reverse the connections to the brushes. This required three or four hours of mechanical work and adjustment. The matter of change of polarity was

"The Exciter Units Were the First to Be Put Into Service and Much Trouble Was Experienced With Debris Lodging in the Nozzles."

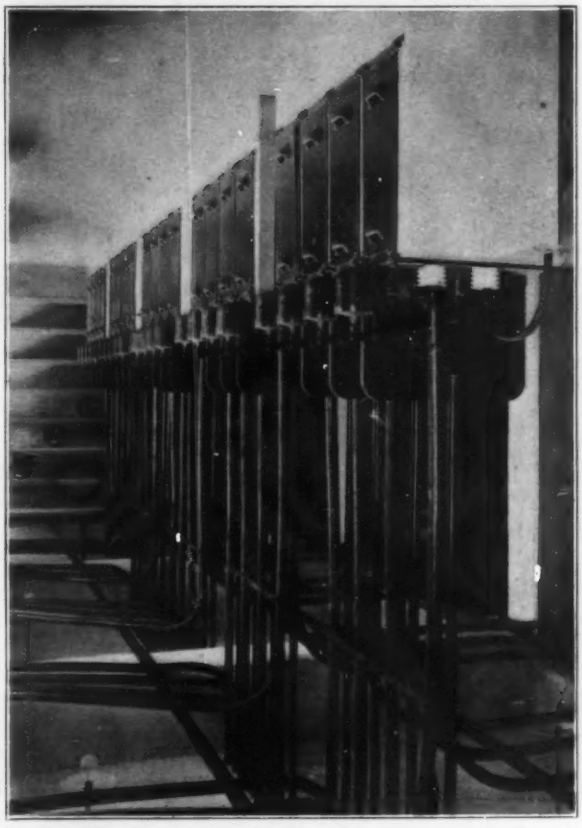
easily accomplished because both field wires ran to the switchboard and could be connected to the field switch of the other exciter for magnetizing current. It was a week before steady running could be depended upon because of stopping of the nozzles with debris from the penstocks. To clear these nozzles it was necessary to take off housing or remove the needle valve. The erector could have saved himself endless trouble if he had crawled through the penstocks and inspected it himself, instead of depending on the steel workers.

D.C. Meters.

As soon as the exciters were in commission the work of trying out all d.c. apparatus commenced with the meters. About half of the meters recorded backwards and had to be reversed. When the controls of the graphic meters were tried out, it was found that, through some mistake, the responsibility for which could not be located, the control coils while wound for alternating current were connected with the direct current circuit and several were injured before the fault was discovered. The d.c. meters were practically all in good calibration.

Remote Control Switches.

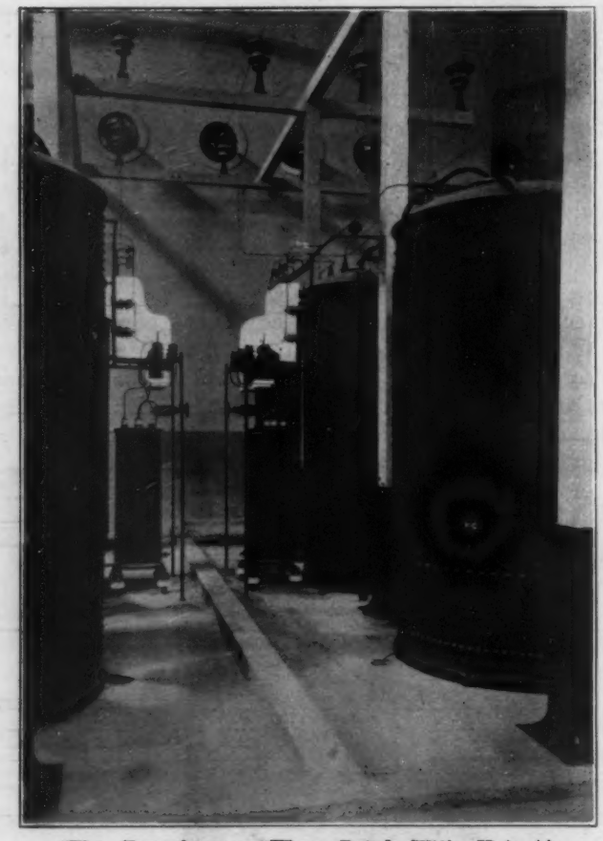
The adjustment of the main exciter switches, which were of air-break type, was a job of oiling and spring adjustment. There was a tendency to stick in the off position and to drop out of the toggles on the in position with high voltage operating current, but patient adjustment with continuous trials put them in excellent running order so that they would operate 25 per cent above and below normal voltage. The air-brake solenoid switches for the fields of each generator required similar attention and careful adjustment by trial. Before the main circuit-breaker switches had been carefully adjusted a couple of small accidents occurred to the switchboard, due to opening of this main breaker with field load on the bus. While each of the generator field switches are provided with field discharge resistance, the main switch is not, so that with three or four generator fields on the main bus accidental tripping of the main switch caused the discharge to jump over at the indicating lamps of the several control switches. At one time the fuses for all of these indicating lamps burned out, and another time all the lamps that were in circuit were burned out. This feature was not made accident-proof, but with care on the part of the operators to throw out field switches first, no such troubles could be repeated. The adjustment of the type "C" Westinghouse oil switches for 6600 volts proved to be a lengthy job. While all contact points had been adjusted in erection so as not to slip a thousandth of an inch, and the tension on the contacts reduced to the finest point, there was still the adjustments of the backlash and solenoid core positions to be made. It was found that while the switches would go in excellently at



"The Adjustment of the Oil Switches Proved to Be a Lengthy Job."

100 volts, that at 130 it would drop out at every attempt to operate the circuit. By adjusting the position of the core of the solenoid so that there was still strain on the mechanism when the core touched the bottom and by careful setting of the limit screws

by trial this rebound was eliminated. Out of nine switches only two would stay in at first, but after one switch had been adjusted for the particular conditions it was a matter of but a few hours' work to put every other one in similar condition. The completion of the adjustment of these switches made operation certain between the limits of 100 and 137 volts. An attempt to operate the switches at 90 volts, even with the most delicate balancing of parts, was unsuccessful. The normal rating of the switch is 125 volts.



"The Transformers Were Dried With Hot Air Forced Through Them by a Fan."

The nine type "GA" Westinghouse oil switches for 60,000 volts presented similar problems except that considerable more difficulty was experienced in getting the first switch adjusted. This switch is slower in action and much more powerful, and the greatest trouble experienced was the re-bound as the switch finished its motion, the toggle mechanism being provided with a hook which fell into place by gravity as the switch came into position. Since the gravity toggle was slow in action, it was a matter of tuning the switch up, so to speak, in order that the hook would just catch the toggles as the switch struck the limits. Filing of hooks and adjustments of the length of the spring contact seemed to give no results, until it was found that more tension on the contacts was needed. After adjusting for additional tension and settling the limit screws to a fine point, the first switch operated throughout a range of 80 to 137 volts. The time required to go in at 80 volts was four-fifths of a second. This is the time between the throwing of the drum handle and the lighting of the indicating light on the switchboard. After the first switch had been thus carefully adjusted to the conditions, the remaining switches were put into service in a few hours.

Transformers.

The transformers were dried with hot air forced through them by a fan, the air being heated with a coke fire. Three transformers were treated at a time. Immediately after the drying process was stopped, the oil was admitted by a pipe line down the hill from the tank cars. The voltage test was made on these transformers long before any other apparatus was tested, current being supplied from the temporary plant. The trial was void of excitement, except such as was caused by poor telephone connections with the plant and blowing of a few fuses.

Generators.

While testing out leaks, all the generators had been turned over slowly, and as soon as the exciters were found to be reliable, the drying out of the generators was started. A short circuit, consisting of heavy cable, was put across the main low tension bus and the generator turned over slowly with disconnecting switches and generator oil switches thrown in. The exciter voltage was then built up gradually until about load and one-half was indicated on each phase of the generator. The thermometers placed in the windings were watched carefully, and it was found necessary to increase the current beyond the scales of the meters in order to get a drying temperature. The load was maintained at a point so as not to injure the windings, although at one time 92 degrees C. continued for some hours. The drying process lasted about thirty-six hours, two of the generators being dried at a time. As soon as these two machines were dry, a full speed test run was made to make sure of the bearings and all moving parts. The water-wheels which were furnished by the Allis-Chalmers Co. being of the single discharge type were provided with multi-step thrust bearing, which attracted considerable interest because of the uncertainty as to the lateral pressure these bearings would have to take care of. It was found that no excessive temperatures occurred. The only difficulty experienced in the large parts of the turbine were with some unsuitable packing chosen for the main shaft. The first one of these to go up in smoke caused considerable excitement until it was discovered just what was going on.

The first current generated was for the purpose of running the local equipment to replace the temporary plant which was shut down at the headworks. For several days one generator carried the operation of pumps, tramway and lights around the plant, and during this time meter men calibrated the alternating current instruments.

The first current to be sent over the wires to Tacoma was on November 5th, when the city's pumping plant, which could be connected direct to the high tension line without going through the substation, was operated for some hours to try out the transmission line and generators. Only hand regulation was used at this time, and there were no eventful experiences, everything running as it should. The city officials after this trial soon became anxious to undertake carrying their own load so as to discontinue the purchase of current as soon as possible, and although but a part of the equipment was ready, the long run

which has continued ever since was commenced, and from then on all adjustments and alterations had to be made with the risk of "spilling" the load.

Tirrill Regulator.

A complete description of the putting into commission of the Tirrill voltage regulator for this equipment would require a re-print of most of the pages of the instruction book which comes with the apparatus, for in this case the generators and exciters were supplied by the Allis-Chalmers Company, the equalizer rheostat and exciter panel by the Westinghouse Company, and the Tirrill voltage regulator by the General Electric Company. The dividing up of the two exciter rheostats into ten equal parts could not be done until the limiting positions were determined by trial, and stop watch, and the limiting positions on the generators could not be determined until after they had been started, so that the Tirrill regulator was the very last thing in service, and the last finishing touch was not completed until about ten seconds before the current was first turned into the line to light the city of Tacoma on a Sunday morning during church services. Good luck in this first preliminary adjustment made a voltage chart like a straight-edge for the first few hours. Afterwards, complete adjustments were required when different conditions of load and regulation were encountered.

Notable among the special experiences with this regulator are the fact that, while the limiting range of voltage of the generator was obtained with the generator rheostat about half in, the best operation of the regulator was obtained with all resistance of generator rheostats turned out. The exciters, while supposedly alike, and of the same speed, would build up or drop down their voltage in different lengths of time for the same change in rheostat positions. With half load on the generators, which was a normal condition, the exciter voltage kept at about 80 volts. It is this condition of low voltage which makes it necessary to have a storage battery, or some substitute for operating the solenoid switches. It had been hoped by the designers to avoid this battery requirement. Without this battery equipment at the present time the operating crew are having considerable inconvenience in switching and synchronizing.

The first current thrown on the line at the pumping station proved to be of the wrong rotation and the current was reversed by changing the cables in the generator pits. Phasing out the several generators was accomplished through synchronizing lamps connected through the potential transformers after testing out the wiring of the potential transformers to the switchboard to be sure of correct connections. Some time was lost in phasing out the last two generators, due to the fact that one potential transformer was partially burned out and gave a wrong reading. It was found that this transformer had been used in the temporary plant and had been half filled with water, which readily accounted for its poor condition. With all the machinery running successfully with hand control, the governors were tried out one at a time with one or two exciting experiences, notably the main bearing of one governor froze up and the machine ran away to its maximum speed. The operators had some excellent experience as to how to get a machine back to hand control without wrecking the plant. The generators were built to stand the runaway speed, but the pumps of the station in Tacoma could not keep up the pace and dropped off the line. An experienced switchboard man hung to his load with no intention of dropping it, and as the Tirrill regulator hung to the voltage the light customers in town never heard of the experience. The tachometer went beyond the range of the dial and so did the frequency meters. The governors, after being broken in and carefully adjusted are giving very high class regulation. The recording instruments of the substation showed better frequency charts than formerly.

Power Factor Meters.

Each generator is provided with a power factor meter. Correct connection to give the true power factor of each generator circuit proved somewhat elusive for the first week. After sufficient load was obtained connections were soon straightened out. The connections as made, following wiring diagrams from

"Half of the Meters Recorded Backwards and Had to Be Reversed."

the factory, caused the instrument to record in the wrong quadrant. Reversing of the potential leads brought them back in the correct quadrant, but with a tendency to indicate an increasing power factor while it should be decreasing. The reversal of current leads was to put the instrument in the wrong quadrant with the proper rotation. Insufficient load would allow the instrument to read almost anything, so that true readings were not obtainable until practically two-thirds load was on and two generators could be run in parallel and their power factors varied by shifting the field rheostats and load. After cleaning up the indicating meters, the recording instruments were even more troublesome, there being two instruments provided, each connected so as to record the power factor for a pair of generators. The current transformers were connected in parallel, but it was found that the best way to get the meters working right side up was by trial, after making sure there was sufficient load to get true readings. The first unsuccessful attempts were due entirely to lack of load. This is a second instance on the adjustments of the plant where much time could have been saved by waiting until sufficient load to give true readings was obtainable.

Spilling of Load.

At two times the load was dropped by accident. One occurred when it became necessary to adjust relays in the substation, the meter-man mistaking the current binding posts for the trip circuit and shorted out the wrong pair. The second occurrence was in trying to parallel the two exciters so as to shift the load from one to the other, one pole of the incoming exciter switch failed to go in and as the operator found it impossible by juggling the rheostats to throw the load to the new machine, he decided he would just trip out the old machine and the new one would have to carry it. This could have been avoided even with this remote control switch by noting that both a red and green pilot light were burning. This spill was somewhat disastrous to the indicating lamps and fuses on the board, as the generator field discharge went through them.

Transmission Line.

The transmission line showed neither grounds nor shorts in starting nor at any time since, although there was some fear of this, due to the fact that hunters had been using the insulators for targets during the period when the line was not operating. At the present time there seems to be no reason to regret the use of aluminum cable, as no lines have been down.

While this article has to do particularly with troubles, the job as a whole was unusually devoid of seriout trouble, due largely we believe, to the fact that only tried and standard apparatus was used, and that a specialist took care of each detail. Now that the plant is completed and been operated for three months, many of the far-sighted decisions of the original engineers can be appreciated, with low operating cost particularly noteworthy. The headworks requires only one man who takes all shifts, the reservoir and its gates together with the operation of the passenger tram require but one man for all shifts. The plant requires one switchboard operator and one oiler for each of three shifts, there being one man who fills the position of chief operator and resident superintendent. The transmission line requires a patrolman stationed at each end of the line and one at the middle of the line. At the substation the city employs the same men they formerly employed when purchasing current.

MONOGRAPH ON FOREIGN ELECTRICAL INSTRUMENTS AND METERS.

The ever-increasing use of electricity has made the manufacture of electrical instruments and meters an important and highly specialized industry, with many complex problems. In view of this fact, the Bureau of Foreign and Domestic Commerce dispatched Mr. H. B. Brooks, an expert of the United States Bureau of Standards, as commercial agent to make a study of this industry in Europe, where much pioneer work has been done in electrical measurements. Mr. Brooks visited the principal manufacturers and obtained such information in regard to their organization, methods and products as would be of interest to American makers and users. In his report, which has recently been issued by the Bureau of Foreign and Domestic Commerce as Special Agents Series No. 66, the works of 31 leading European firms are described.

ENLARGING THE BEAR RIVER DITCH.

BY RUDOLPH W. VAN NORDEN.

(Concluded.)

General Characteristics of Ditch.

For the first four or five miles, the canal follows closely the steep bank of Bear River, and when first constructed, consisted largely of wooden flume, the timber being cheap and easily accessible. The remainder of the canal was a ditch in earth and was, as may be seen by a glance at the map, a very crooked affair, necessitating a mileage about double the air-line distance between the intake and Auburn. It was remarkably located for grade and safety of construction, as 60 years of continuous use has proven. While there are many stories told, and even to this day may be seen evidences of canal failures through faulty location and survey, this canal was well designed. As the flumes depreciated, many sections were replaced by ditch, although a few remained, and in the enlargement this type of construction has been maintained.

In the old line there was but one tunnel—this known as the Ragsdale tunnel, named from a pioneer employee, whose property the tunnel passed through. This tunnel is largely in rock, although there is some timbering. It has a length of 1377 ft. The grade of the canal is remarkably uniform; for 5½ miles from the intake it is 5.8 ft. per mile, the next 8½ miles has a grade per mile of 2.75 ft., and the lower end varies somewhat, but averages 3.7 ft. per mile. The old ditch has a trapezoidal section, the bottom width being 5 ft. maximum, the top width, 8.5 ft., while the depth below the berm averaged 4 ft.; the depth of water was 3 ft. The sides had a slope of 1 horizontal to 2 vertical. The flumes, which were of typical California construction, had an inside width of 5 ft. and a depth of 4 ft.

Foreign Labor Problem.

The problem was one of works organization. For this purpose, the work was put into two divisions—the first, extending from the intake, a distance along the canal of 11.3 miles, while the second division has about the same length, following the altered line.

There were established, along the line of canal, ten camps, and at New England Mills station on the railroad, a storehouse and receiving camp, all operated by the company. Four of the canal camps have compressor plants to supply compressed air for the work, and one, known as the Applegate camp, being a headquarters for the lower division, established in a farmhouse bought by the company. There are several camps for Greek and Turk laborers, who run them themselves. At Colfax the company headquarters was established in a commodious office building, from whence the engineering work is directed and which is also headquarters for the upper division.

While there is always a more or less migratory movement among the laborers, there has been little difficulty in keeping full crews, except during a few days in January, when the weather was unusually cold. Laborers receive a uniform wage of $2.50 per day and, except in the camps where they attend to their own mess, pay the usual price of 25 cents per meal.

The use of Southern European labor has been very successful, both Greeks and Turks giving satisfaction. Of course, for the peace of mind of all con-

cerned, the nationalities are not mixed, each having their own camp some miles apart. One often hears adverse comment on the labor value of these people, but it was soon learned by these laborers, particularly the Greeks, that the pernicious practice, which has unfortunately prevailed to a greater or lesser degree in California, that of having to "buy his job," by paying a regular percentage of his pay to the foreign" boss," who in turn shares with the foreman or whoever may have control of the hiring of the men, would not be necessary or tolerated by those in charge of this work.

Portable Boiler Outfit Supplying Steam to Burleigh Drills.

This has caused a state of mind among the foreign element which has had a remarkable stimulating effect and may be a reason for the good results obtained in comparison with the work at other points.

The greatest number of men at work at one time was in December, when there were about 2300 all told.

A record of work done and the men employed during a week in January on the upper half of the canal, follows:

	For Week.		Daily Average.	
Excavation:	Cubic Yd.	Lin Ft.	Cubic Yd.	Lin. Ft.
Hand excavation	14,585	4,850	2,080	692
Steam shovel excavat'n.	10,259	3,420	1.468	489

Force:	
Engineers	16
Accountants, clerks, etc.	20
Foremen	25
Mechanics	221
Laborers	1,470
Total	1,691
Head of stock	100
Men per foreman	67
Steam shovels	3

With this comparatively large and unusually well organized force the time limitation for the completion of the work is not a source of anxiety, as, at this time, nearly a month before water must be turned in, the work, with the exceptions of the tunnels, is practically complete.

Bridges.

The great size and width of the canal makes the overhead road crossing assume the importance of a bridge of no mean dimensions. There are 6 bridges where county roads cross the canal. Part of these are straight and part skew. They are of reinforced concrete in a single span and have three beams, 20 in. deep and 12 in. wide, while the floor of the bridge is a reinforced slab, 10 in. thick. An ornamental concrete wall railing is provided on both sides of the bridge.

Method of Excavating.

Excavation has been done by hand and scraper and by steam shovel. In the beginning of the work, a big start was made by handwork before it was possible to get the steam shovels on the job. This has probably caused the total cost of the work to be higher than it might have been if the shovels had been introduced earlier, but was justifiable from the absolute necessity caused by the limited time available.

The material excavated is of all sorts. There is very little that is not in part, at least, rock, and much that was practically solid rock. Much hardpan, or disintegrated rock necessitating blasting was encountered. There are sections where a clear gravelly clay practically free from rock was found, and at these places the work progressed very rapidly.

The method of operation while excavating by hand was to commence the cut on the upper bank, either by pick and shovel, plow and scraper where the ground slope would permit, or by drilling and blasting. With handwork the earth is taken out in layers until the bottom of the cut is reached. Blasting was very carefully done, low percentage dynamite being generally used. The handwork while slower and more costly was neecssary in places where there was danger of shattering the outer berm by heavy blasting and the steam shovel.

There were four steam shovels used on the work. These are Marion No. 41 shovels with 1½ yd. dippers. The work of blasting preceded the shovel, the holes being drilled to the bottom of the cut and the broken soil as the result of the blast being allowed to fill the old ditch. The shovel takes out the spoil without difficulty, leaving the section fairly to gauge. It is then necessary to follow with hand labor to trim the cut to template.

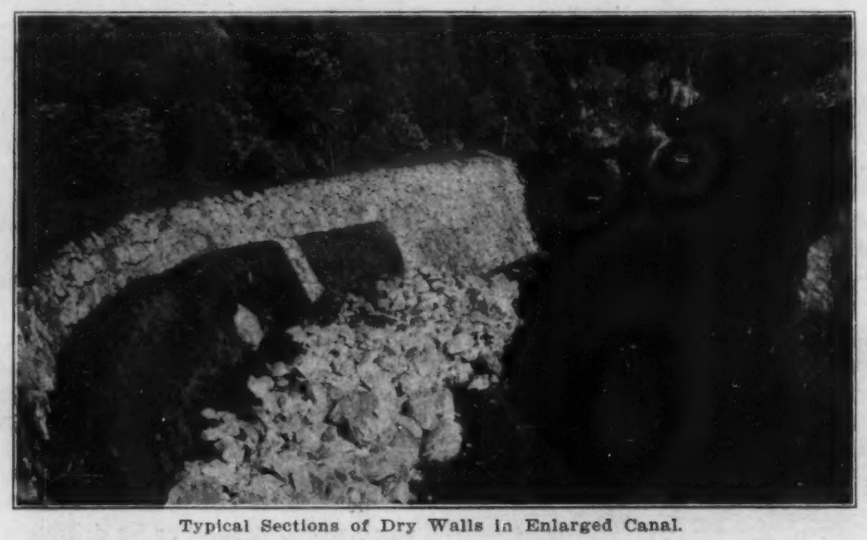
The company was fortunate in having a number of good dry wall builders, and these men have placed a remarkably permanent and smooth wall in the lower berm.

Much ingenuity was necessary to get water and fuel to the steam shovels. Wood was purchased and cut at various points and was hauled along the bottom of the canal by three horse teams to the shovels. Water was piped in various ways from any available source. In one instance a gasoline pumping plant was installed in the bed of Bear River.

An innovation was introduced on this work at one point in the shape of Burleigh steam driven drills, supplied from a portable boiler. This boiler, a small one of the locomotive type is mounted on wheels which run on a temporary track placed on the canal berm. Water was hauled to a tank, also portable. No data is as yet available as to the relative cost of this expedient under the specific conditions however, it was satisfactory.

This work as well as the entire Lake Spaulding development is being done by the engineering force of the Pacific Gas & Electric Company and is under

the general supervision of Mr. Frank G. Baum. Mr. H. C. Vensano is civil engineer. For the upper half of the Bear River enlargement work, known locally as Division 3, Mr. G. C. Noble is the engineer in charge and Mr. James Martin, division superintendent of the Colfax water district of the company, is in charge of the construction work. In the lower section, known as Division 4, Mr. Paul E. Magerstadt is the engineer in charge, while Mr. D. H. Duncanson has charge of the construction work including driving the tunnels.



Typical Sections of Dry Walls in Enlarged Canal.

PURIFICATION OF GAS

BY E. C. JONES.

(Concluded.)

The amount of water used in washing gas ranges from 10 to 15 gallons per ton of coal carbonized. The ammoniacal liquor in the washer also removes a considerable amount of sulphuretted hydrogen and carbon dioxide from the gas. The effects of condensing and scrubbing on crude gas are about as follows:

*Gas.	H_2S grams per 100 cu. ft.	Ammonia grams per 100 cu. ft.	CO_2 per cent by volume.
Outlet Exhauster	610	231.1	2.57
Outlet Condensers....	590	196.4	2.34
Outlet Scrubbers	470	93.1	1.98
Outlet Rotary Washer	400	.37	1.58

*Mr. W. H. Fulweiler.

[1]Coal Tar and Ammonia by Geo. Lunge.

Only about 1/5 of the nitrogen of the coal is recovered as ammonia, and most of this during the latter part of the distillation period.

Ammoniacal liquor is usually sold by the gas companies to outside manufacturers, although some companies and many of the coke oven plants convert the liquor into ammonium sulphate and other products. The strength of the liquor is expressed in ounces, and refers to the number of ounces of real sulphuric acid required to neutralize each gallon of ammoniacal liquor. The Twaddell hydrometer was formerly used to determine the strength of liquor; each degree Twaddell corresponding to two ounces of strength, but this method is not reliable, and is much to the advantage of the purchaser. A better way is to use a standard acid solution, specific gravity 1.068, and for each 16 liquid ounces of the ammoniacal liquor the number of ounces of the standard acid solution used to neutralize it indicates the number of ounces of real sulphuric acid (H_2SO_4) required for each gallon of ammoniacal liquor. Litmus paper is used to indicate neutrality. The amount of ammoniacal liquor produced in the coal gas works varies with the quality of the coal, and the temperature to which it is subjected in distillation, and ranges from 13 gallons to 45 gallons of 8 ounce liquor per ton of coal carbonized. The usual amount is about 25 gallons.

A fair yield of ammonium sulphate per ton of coal is 20 pounds. The importance of this industry is shown by the world's production of sulphate of ammonia for the year 1912:

	Tons.
Germany produced.....	465,000
United Kingdom produced.....	379,000
United States produced	165,000
France produced	68,500
Belgium produced	49,500
Austria-Hungary and the rest of Europe..	170,000
	1,297,000

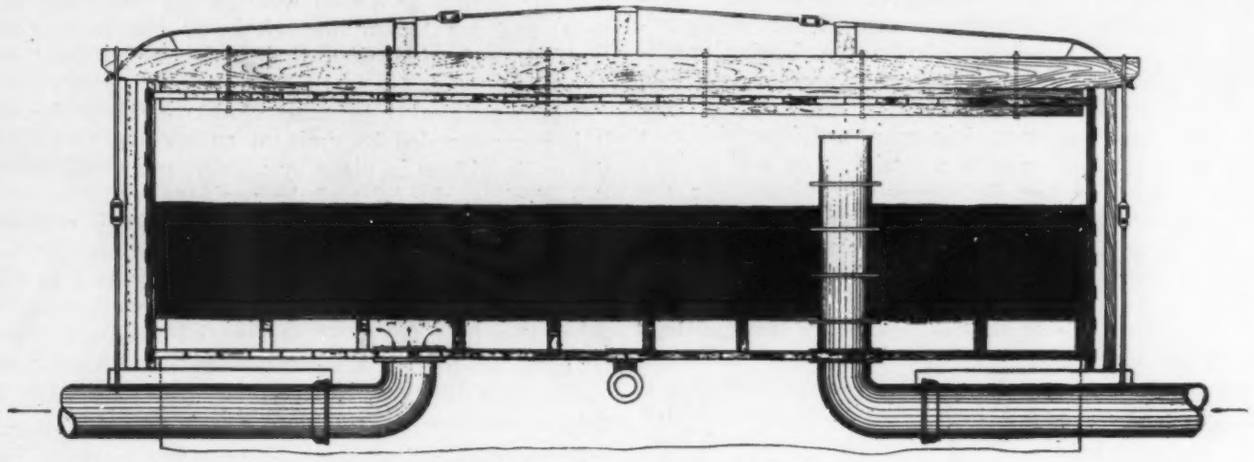
The next step in the treatment of the gas is purification for the removal of sulphuretted hydrogen, organic sulphur compounds, and carbon dioxide.

The first efforts in this direction were made by Clegg when he mixed quicklime with the water in the gas holder tank at Halifax. This did not insure sufficient contact between the hydrate of lime and the gas to accomplish the expected result but in 1815 Accum, in a treatise on gas-light, described a lime machine which utilized a cream of lime as a purifying agent. This is the most efficient and economical form in which lime can be used for gas purification.

This method was used until the '50s, and its use was reluctantly abandoned on account of the difficulty

of disposing of the spent lime known as "blue billy.'

In conjunction with the milk of lime purifiers, a copperas washer was used. The general design of this piece of apparatus was the same as the wet lime purifier, but a solution of copperas in water was used instead of the milk of lime. The copperas washer was soon abandoned, but attention is called to it now because of recent demands for cyanides for the recovery of gold from low grade ores. The source of these cyanides is the cyanogen extracted from coal gas, and the process employed by Dr. Bueb consists in scrubbing the gas before its ammonia and sulphuretted hydrogen have been removed, with a solution of copperas in water. It has been found that the "Standard" scrubber is well adapted to treat the gas with copperas solution. The use of dry lime for purifying was invented by Reuben Phillips of Exeter in 1817, and on account of the convenience of handling and the easy disposal of the refuse, the gas engineer adopted a method which reduced the purifying value of lime from 14,000 cubic feet to 5000 cu. ft. per bushel of lime, thus over 64 per cent of the value of the purifying material was sacrificed to convenience, and to avoid nuisance.



Sectional Elevation of Jones Gas Purifier.

In the days of Phillips, dry lime purification meant the passage of gas through a series of thin layers of lime powder in the purifier, which at its best would not extract the impurities from over 5000 ft. of gas per bushel.

This method was used until 1875, wher Mr. Theobald Forstall of New Orleans taught the gas engineer to nearly double the efficiency of lime, and reduce the back pressure in the purifier by a simple method of treating the lime. More water was used in slaking the lime, and the slaked lime was passed through a wire screen which reduced it to granular pellets the size of a hickory nut.

The proper degree of moisture was found to be that beyond which any excess would cause the "dough" to adhere to the screen instead of breaking through. The dry lime weighed 60 lb. to the bushel, while lime prepared by this method weighs 92 lb. per bushel.

Lime purification removes the carbon dioxide, sulphuretted hydrogen, and organic sulphur compounds, and the spent lime in the boxes first in series removes the carbon disulphide. This is ideal gas purification, but the expense for lime and labor, and the provision of dumping ground for the waste material brought about a search for a less expensive method.

Oxide of iron purification was patented in 1840, and in 1849 a French patent was granted, which included mixing sawdust with the iron, and specifies that it may be revived by contact with the air and used again.

It was a hard struggle for conservative gas men to adopt a new method of purification which did not remove all the impurities although it promised a large saving in cost, but it began to be understood that a small amount of carbon dioxide was not very harmful in the gas, and that as long as no sulphuretted hydrogen was permitted to remain in the gas a reasonable amount of sulphur compounds did no harm, and so oxide purification was adopted.

The material known as iron oxide is hydrated ferric oxide. This occurs naturally as bog ore or may be manufactured by rusting iron borings, or using copperas as a source of iron.

In the making of oxide of iron for gas purification, the proper amount of copperas for a batch to be mixed is placed in barrels and a very small amount of water added, the water of crystallization of the copperas being almost sufficient to liquify when the copperas is heated slightly by steam, steam being blown directly into the barrels. Sawdust sufficient for a batch of oxide is levelled off on the floor to a depth of about 8 or 10 in. The copperas in the amount of 20 lb. to the cu. ft. of sawdust is then poured over it and turned over until thoroughly mixed. Lime in the amount of 10 lb. to the cu. ft. of sawdust is then slaked to a consistency which will hold the form of a hand when a portion of the lime is squeezed. Half of the lime is then mixed with the copperas and sawdust, and the mass turned over and packed with the flat side of a shovel until no lime is perceptible. This is allowed to oxidize for 24 hours, when the second half of the lime is added in the same manner and is again turned over and allowed to oxidize. Before stacking as finished oxide, the mass should be turned at least five or six times to allow thorough oxidization, and to prevent over heating.

Formula.

Bushel.	Pounds.	Pounds.
1 Sawdust.	12½ Slaked Lime.	25 Copperas.
	Or	
Cu. Ft.	Pounds.	Pounds.
1 Sawdust.	10 Slaked Lime.	20 Copperas.

Iron borings rusted by a solution of sal ammoniac in water is sometimes added to advantage.

Until recently the accepted shape of purifier was a square pan-shaped vessel made of cast iron plates, and provided with a sheet steel cover fitted to a water seal, or lute joint, around the top of the purifying box. This joint is gas tight and saves much time over any method of fastening a cover by bolts. The area of the boxes is according to the capacity of the gas works, while the depth was at first from 3 to 4 ft. and is now increased to greater depths. The new purifiers at the Astoria Plant of the New York Consolidated Company are 40 ft. square and are 8 ft. in depth, containing 2 layers of oxide 42 in. thick each. Purifiers are usually arranged in groups of four, either in the form of a square or in a straight line, and as it is necessary to change the sequence of boxes for the purpose of renewing or reviving the purifying material, the course of the gas is regulated by a center-seal, (a dry seat revolving valve which connects three boxes in regular sequence and completely shuts off the gas from the fourth) or preferably by a system of valves so arranged that the sequence of the boxes may be changed at will and all four boxes used at one time. This method increases the purifying capacity of the works by permitting the use of the fourth box.

When lime was used to purify gas six thin layers (from two to four inches thick) were used. These were finally reduced to two thicker layers. Oxide of iron was first used in two thin layers, and as it became evident that the back pressure was not seriously increased by using thicker layers of purifying material, the depth was increased until modern purifiers are filled with oxide in one layer, from four to six feet deep.

The reactions of oxide of iron in removing sulphuretted hydrogen from gas are:

$$Fe_2O_3 + 3H_2S = Fe_2S_3 + 3H_2O, \text{ and}$$
$$Fe_2O_3 + 3H_2S = Fe_2S + S + 3H_2O$$

simultaneously and the proportion is 3 parts of the ferric sulphide and 5 parts of the ferrous sulphide.

Cyanogen when not removed combines with the iron forming Prussian blue.

The great advantage of oxide of iron purification over any other, is that after it has performed its work it may be revivified by bringing it in contact with the air, and it may be used and revived until the sulphur content reaches above 50 per cent of the weight of the purifying material.

It was at first the practice to remove the oxide of iron from the purifier each time after it had done its work and spread it on a floor, turning it until each particle had been revivified by contact with the air. An improvement on this method consisted in raising the cover of the purifier and drawing air downward through the purifying material by means of a steam jet exhauster, or a rotary fan exhauster. This method saves time and labor and prevents the breaking up of the oxide by handling.

Following is a typical analysis of spent oxide:

	Per Cent.
[1]Ferric oxide	26.71
Metallic iron	.06
Free sulphur	54.56
Prussian blue	2.56
Tar	4.11
Wood shavings	12.00
	100.00

[1]Mr. W. H. Fulweiler.

The period of revivification is from two to four hours, at the end of which time the material is ready to be used again.

Air should be drawn through the purifying material and not blown through it, as blasting causes local revivification with the generation of heat so intense as to set fire to the oxide.

It is customary in many modern gas works, and it is recommended by eminent authorities, to revive the oxide of iron in place by admitting a small quantity of air at the inlet of the purifiers. The air provides the necessary oxygen to continuously revivify the purifying material without taking the purifier out of use. The amount of air necessary is from 2 to 2½ per cent of the volume of the gas. One authority states that from 0.5 to 0.7 per cent of oxygen is theoretically needed for the continuous revivification of oxide. The discovery of a method of producing cheap oxygen would at once make this an ideal method of revivifying oxide.

The latest type of purifier adopted by the larger gas works in California, is a series of round wooden boxes made of redwood staves. These boxes are 30 ft. in diameter and 9 ft. deep. The top of the boxes is covered with water to a depth of about 2 in., and grooves between the staves connected by holes passing through the staves provides a system of water soaked gas tight boxes. The heads of the boxes are of redwood, and doors are provided on the top head and at points on the side for filling and emptying, and for the admission of air while revivifying. The oxide of iron is placed on wooden girds, in one layer of any desired thickness. It is customary to use a layer from 5 to 6 ft. deep. These boxes have a daily purifying capacity of one million cu. ft. of gas each.

After leaving the purifier, the gas passes to a station meter where it is measured and is then stored in the gas holder ready for distribution.

HYDROELECTRIC DEVELOPMENT IN PRUSSIA.

The British embassy at Berlin states that a bill has been laid before the Prussian Diet for the development of water power on the upper waters of the Weser. It provides for an expenditure of $2,142,000, of which it is proposed to spend immediately only $1,190,000 on the erection of power stations at Hemfurt and Helminghausen; the remainder will subsequently be spent on the construction of a power station at Munden. It is estimated that the three stations can produce 41 million kilowatt hours annually.

ELEMENTS OF STEAM POWER PLANT DESIGN

ADVANTAGES OF HIGH VACUUM AND SUPERHEAT. IV.

BY C. R. DELANEY.

Since the introduction of the steam turbine into power plant work, the condensing equipment has assumed much greater importance than it formerly possessed. The reason of this is that a steam turbine is able to utilize a much greater degree of vacuum than a reciprocating engine. With the usual proportion of cylinders in a compound engine, the maximum ratio of expansion of steam in a reciprocating engine is not over 20:1. In the case of the steam turbine on the other hand, we have a ratio of expression of 120:1 operating with a vacuum of 28½ in., or if the vacuum is increased to 29 in. the ratio of expansion becomes 180:1. You are all famiiliar with indicator cards of reciprocating engines. It is customary for the designer of reciprocating engines to draw a theoretical indicator diagram, plotting the volume of the cylinders as abscissae and absolute pressure of the steam as ordinates. This diagram enables him to study the various operations of the steam in the cylinders; the point of cut-off,

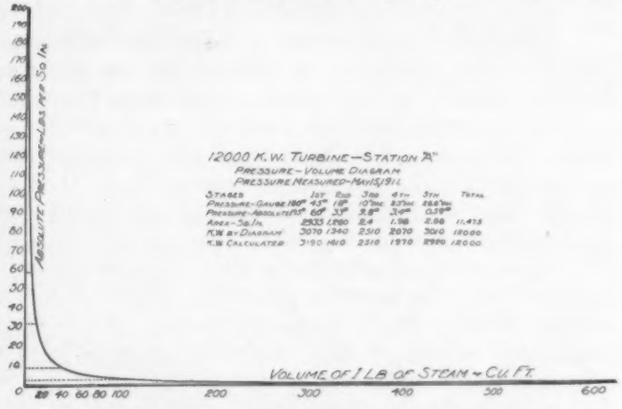

12000 K.W. TURBINE—STATION "A"
PRESSURE-VOLUME DIAGRAM
PRESSURE MEASURED-MAY 5/1911
ABSOLUTE PRESSURE-LBS PER SQ IN.
VOLUME OF 1 LB OF STEAM-CU FT.

Fig. 1. Illustration of Impracticability of Pressure Volume Diagram for Turbine Design.

release, compression, etc. Fig. 1 shows a similer theoretical diagram made for a steam turbine. In this case, instead of laying off the volume of the cylinder on the diagram, I have laid off the volume of one lb. of saturated steam. You will at once see that owing to the large volume of the steam at high vacuum, it is necessary to use a very large sheet in drawing the diagram, as with the diagram drawn on an ordinary sheet, the scale is so small that it becomes practically useless. For these reasons it is customary for designers of steam turbines, instead of using the pressure volume diagram, to make use of the temperature entropy diagram, an example of which is shown in Fig. 2.

Entropy is an imaginary quantity defined as the quotient of quantity of heat divided by absolute temperature, consequently if we lay off entropy as the length on a diagram and absolute temperature as th height, then the area of the diagram represents quantity of heat or the amount of energy available between any two conditions of expanding steam. The use of entropy diagrams simplifies calculations and makes it possible to use graphical methods in cases where the pressure diagram would be useless.

The diagrams reproduced in Figs. 1 and 2 were made for the purpose of ascertaining the proportion of work done in the several stages of a Curtis steam turbine. The pressure volume diagram (Fig. 1) was first made, and horizontal lines were drawn corresponding to the pressure in the different stages. An attempt was then made to measure the area of each portion of the diagram, but owing to the great length of the diagram in proportion to its height in the low pressure end, and its great height in proportion to its length in the high pressure end, it was found that the slightest inaccuracy in drawing the diagram led to considerable error in the final results. The use of this diagram was therefore abandoned, and the Temperature Entropy diagram was adopted in its place. A glance

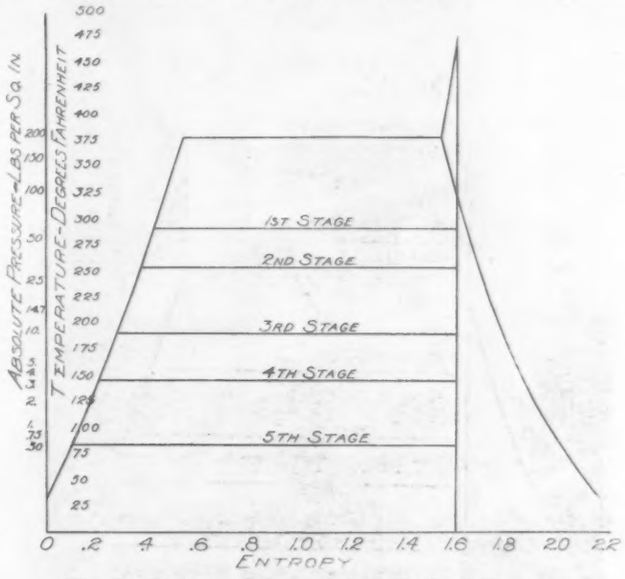


Fig. 2. Method of Determining Work of Steam in the Various Stages of a Steam Turbine by the So-Called Temperature-Entropy Diagram.

at this latter diagram (Fig. 2) shows that at the time the readings were taken the first stage was doing more than twice as much work as the second, and the third and fifth stages were also doing more than their share of the work. Certain adjustments were made which corrected this condition, so that diagrams made at a later date, showed an equal distribution of load among the different stages, and in consequence better results were obtained from the turbine. Thus the temperature entropy diagram may be used in making adjustments on a steam turbine, just as indicator diagrams are used in setting the valves of a reciprocating engine.

A study of entropy diagrams indicates at once the great value of high vacuum in connection with the operation of steam turbines. At the time the diagram shown in Fig. 2 was made the vacuum was 28.8 in., corresponding to a steam temperature of 85 degrees F. Had the vacuum been only 26 in., which is considered good practice for reciprocating engines, the steam would not have expanded below the dotted line AB,

which corresponds to a temperature of 125 degrees F., and all the energy represented by the area A, B, C, D would have been lost. It is found in actual practice that an increase in the vacuum of 1 in., say from 28 in. to 29 in. reduces the steam consumption of the turbine almost 7 per cent and is as effective in this respect as an increase of the steam pressure of 70 lb. This reduction in steam consumption per kilowatt hour means not only a material saving in fuel but also will result in an increase of capacity of the whole station. Steam turbines are designed with nozzles of suitable size to admit the proper amount of steam for maximum capacity for which the machine is designed. It is use-

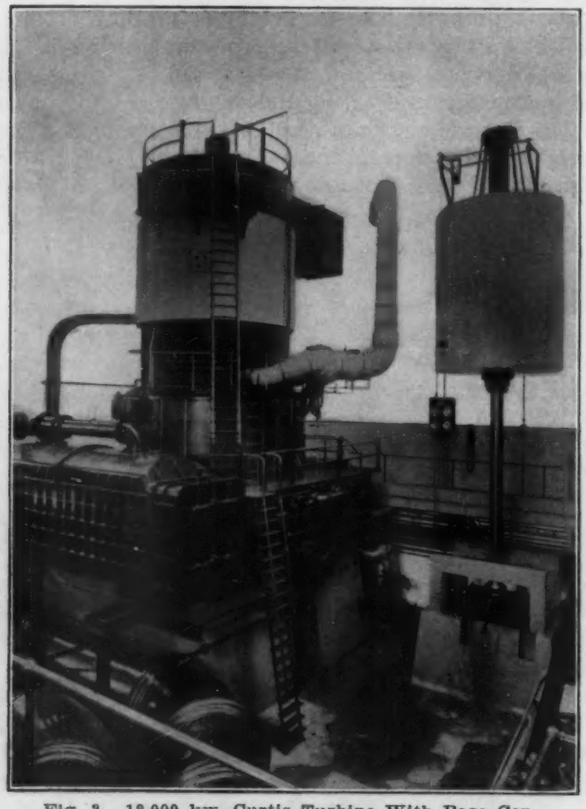


Fig. 3. 12,000 kw. Curtis Turbine With Base Condenser and an Additional Auxiliary Condenser in Separate Shell.

less to supply more steam to the turbine than this maximum, as it simply will not pass through the nozzles. Consequently if it is desired to carry a greater load on the machine, it is necessary to look to the low pressure end for relief rather than the high pressure end, and by increasing the vacuum we find it possible to increase the capacity of the machine by an amount equal to the per cent of increased efficiency due to the higher vacuum. In some cases an increase in the vacuum may save the installation of additional boilers. Suppose for instance, a plant has not sufficient boiler capacity to operate the turbine at full load, a gain of 7 per cent on a 12,000 kw. plant due to an increase of 1 in. in the vacuum is equivalent to an increase in capacity of 840 kw., which otherwise would only be obtained by installing an additional boiler.

Superheated steam also has a marked influence in increasing the efficiency of steam turbines. Superheaters are usually installed in the boiler settings and in fact become integral parts of the boilers. The gases from the furnaces are made to pass over the superheater after passing over part of the heating surface of the boiler, and after leaving the superheater the gases travel over the remaining portion of the boiler. The advantage of superheated steam in the operation of the steam turbine, lies mainly in the fact that superheated steam is a rarer medium than saturated steam, consequently the friction of the rotating buckets of the turbine traveling through the steam at a high velocity, is less when superheated steam is used than with saturated steam. Another reason for the advantage of superheated steam is that the superheat increases the volume of the steam to a marked extent, and on account of the greater volume there is less leakage passing the ends of the blades in the turbine. In practice it is found that 100 degrees of superheat results in a saving of about 8 per cent in steam consumption. This is not all a net gain, however, as it takes more fuel to generate superheated steam than the same weight of saturated steam. The extra fuel required to superheat the steam 100 degrees amounts to about 5 per cent, so there is a net gain of 3 per cent.

WESTERN STATES COMPANY'S COMPLAINT DEPARTMENT.

The complaint department of the Western States Gas & Electric Company is probably the best equipped department of any public utility company in the West. A great many inquiries have been received from other utility companies for information concerning it and its operation. To one of these inquiries, A. G. Halloway, who is in charge of the department replied in part as follows:

"The policy of the department is to shape its attitude towards the public so that the patron is bound to feel that by simply calling attention to a real or imaginary wrong it will receive prompt attention. We feel that a patron making a complaint is honest in his belief that a wrong exists, and no matter how small the complaint or how trivial it may be, we go into it thoroughly. When a complaint is entered we are very careful to get the correct name and street number. We try to find out the cause of the trouble when receiving the order, thus enabling us to determine to whom the order should be sent for prompt execution.

We also keep a book entry of all complaints. We have a day trouble man and a night trouble man for both gas and electric departments. The night men turn in their orders each morning, in that way we are conversant with what has transpired during the night. I feel that I cannot place too much importance on the subject of handling complaints, the way the customer is received and the interest taken in his complaint. I believe the success of a complaint department depends chiefly on the man at the head of it. He must thoroughly understand the business, as he must necessarily deal not only with high bills, poor service, setting of or removing meters, adjusting overcharges, re-reading meters, opening and closing accounts and testing meters, but in fact settling any and all disputes. To do this the head of the department must be able to receive all complaints against the entire company in such a way as not to offend the customer."

ELECTRICAL PUMPING AND IRRIGATION

WASTEWAYS OR ESCAPES ON CANALS.

BY. B.| A. ETCHEVERRY.

Wasteways or escapes are used to turn a portion of the whole of the water from the main canal into the river or in some natural drainage channel. This is necessary when a break occurs in the canal or when an excess of water enters the canal. When a break occurs it is a big advantage to be able to divert the water out of the canal through an escape above the break. When no escapes are provided the water can only be stopped by closing the headgates. This usually requires considerable time to reach the gates and a longer time before the water already in the canal will drain out through the break; consequently the break will be much more serious. For these reasons it is very desirable to have wasteways at many points on the line and especially above those points where a break would cause the greatest damage, such as above long stretches where the canal is in fill, above flumes, siphons and other important structures. The most favorable location for a wasteway is where the canal passes near the river or a natural drainage channel. This will often be above the head of flumes, siphons or fills.

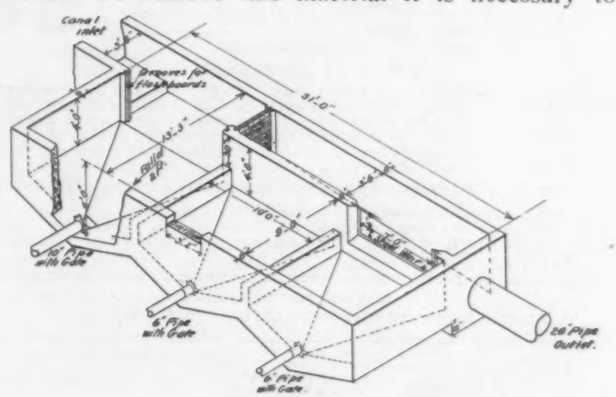
The structure will usually consist of (1) a cut made in the bank of the canal extending from the top of the bank to the floor of the canal or lower. A narrow cut may require only one gate, but a large one must be divided by piers or columns into a series of openings closed with gates; (2) a wasteway or escape canal which carries the water to the nearest suitable drainage channel.

If the floor of the escape openings is at the same level as that of the canal, when the gates are opened part of the water will pass through the gate openings, but another portion will flow on in the canal. The proportion depends on the total width of escape openings as compared with the size of the canal. To pass the entire discharge through the escape two methods are used: (1) The sill or floor of the opening is depressed sufficiently below the floor of the canal to make the entire volume of the water flow through the escape. (2) Check gates are used across the canal and the wasteway is placed directly above them. By opening the escape gates and closing the check gates the entire volume will be forced through the escape which must be of sufficient capacity.

Often the escape can be combined with one or more structures. It may be built with the inlet of a flume or siphon; it may be formed to serve also as a sandgate or may be combined with a drop and check-gate across the canal. The principles governing the design of the gates will be the same as those explained for headgates. The waterway, canal which has generally a steep slope, may be constructed as a chute or may require a series of drops. The design of these is considered farther.

Sandgates—Sandboxes.

Sandgates are intended to remove the sand and silt carried by the water and deposited in the canal. They can also be used as waste gates. The efficiency of sandgates is often very low and where possible it is much preferable to design the headgates so that little material will be carried into the canals and to design the canals so that what does enter the main canal will be carried to the fields. The difficulty in removing sand and silt is due to the following conditions. When the water entering into the canal carries silt and sand in suspension, deposits will form wherever the velocity falls below the transporting velocity of the material. To remove this material it is necessary to



Sand Box.

create by means of sandgates a scouring or erosive velocity sufficient to overcome the cohesion of the deposited particles. The normal velocity which has permitted these deposits is less than the transporting velocity and is very much smaller than the required erosive velocity, especially if the deposited material packs with considerable cohesion. It is difficult to create this higher erosive velocity and the effect of the sandgates is limited to the section of canal near them. In designing these structures it is necessary to know the character of the material transported, whether sand or silt. Sand is more liable to form deposits in the canal. It is transported on the bottom of the canal, the coarser particles rolling on the bed. Silt is more evenly distributed in the water and the finer silt generally should be transported to the fields where it may be of considerable value.

There are two general types of structures. The first one is better adapted to waters carrying sand. It consists of a sand trap which collects the sand as it moves near the bottom of the canal and discharges it into a waste channel. The second type is better adapted to finer material. It is formed by a depositing basin where the velocity of the water is reduced sufficiently to cause a deposit of some of the material, which is washed out through sluice gates into a waste canal or chute and carried to some drainage channel.

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With regard to the item on "New Water Code Provisions" on page 221 in our issue of March 8th. This should be credited to the State of Washington and not to the State of Oregon.

What picturesque visions flash by the thinking mind at the mention of the words "starting-up experiences"!!

Starting-up Experiences

Our leading article of this issue is interesting considered as a detailing of the many unforseen, pestering trifles and experiences which happen when putting into operation a new and high class hydroelectric installation. By its careful perusal it may serve its part in lessening such trying difficulties in the future. But the most forceful lesson one learns in following the many obstacles encountered in getting started upon a new task of this sort, is the symbolic applications that may be made to the initial steps in all new undertakings of the business and commercial world.

Let us consider for a moment some of these analogies. The hard-opening gate, controlling the supply of power developing water, illustrates the friction and inharmonious characteristics of a newly constituted board of managers, which in time by means of levers and careful inter-adjustments will allow to issue forth the life-giving orders that will control the energies of half a hundred industries. The countless leaks sure to spring forth as the penstocks swell with pressure may be likened to the many financial leaks and losses encountered before properly appointed systems of accounting and detailed checking are enforced to keep the energies of the company in its proper channels. The wrong compounding of the exciters remind us that in any business two energizing forces in management may be present, which if operating separately may each supply the vital fields of magnetization of action and yet when utilized in the same circuit of action they must pull in the same direction or little useful results follow. Indeed in the operating circuit the backward reading of meters improperly connected remind us that not only may energy be not registered or in other words be passive, but even negative output may be recorded instead of positive results.

The drying out of the transformers and generators, like the trying out of new men, often brings to light defects in construction and improper internal make-up. By a careful analogy of such starting up experiences we learn to avoid the hasty size up, both of men and material.

Difficulties in remote control switches, their oiling and spring adjustment, teach us the defects to be avoided in the lack of composite organization. The backward reading of alternating current meters due to the control coils being connected to the direct current meters tell us of the disasters that may follow due to the overlapping of authority. Lack of synchronism, too, in all of the workings may cause the load to spill as happened in the case at issue and happy is the business management which has the delicate yet powerful governor that can manfully steer the organization through the runaway experience that inevitably follows.

When serious thought is given to the starting or beginning of hydroelectric development in the West, how remarkably similar appears the early workings of this productive activity. The time of second thought being now upon us it well behooves the management of today to consider carefully all the experiences and vicissitudes of former years in launching new enterprises. Thus will be built up in these days of substantial growth the real assets and valuations that such enterprises merit.

The Bohunk Laborer and the Rake-off

The question of securing common labor is one that affects the hydroelectric fraternity equally as deeply as it does the railroad contractor and other outfits where human physical effort is required to perform the major portion of new development work.

The Turk, the Greek, the Montenegrin, the Servian, and the Bulgarian laborer, known throughout the West as the "bohunk," is usually paid his daily wage by one of his fellow countrymen after the said fellow countryman has deducted from twenty to thirty per cent for his professional services, and for the rake-off of the foreman, who is in addition fully paid by the construction company itself.

Oftentimes the leader of such a gang of foreigners is the only one who speaks English in any intelligent manner whatsoever, hence it is argued that since these foreigners usually depart at a later date for their own country and since ample supply of labor is thus assured this method of procedure is thoroughly justified.

To look at the average "bohunk" laborer one may easily imagine that he sees what may be technically described as simply a "physiog" and not a human face. Hence justification of the degrading rake-off instittuion is easily argued to the faltering conscience. The wrong, however, is not alone done to these human devils, because its greatest baneful effect is reflected in the attitude and ethical standard left throughout the corps of managerial workers who must stand by and suffer such practices to continue. Indeed its influence is not of such a passive nature. The rank and file of bookkeepers, timekeepers, straw bosses and other trusted employes of the company must have their standard of honesty and loyalty to the company correspondingly lowered.

Again, management of all affairs pertaining to public utility activity is now the subject of close and critical scrutiny on the part of the general public. Evolution in utility affairs strongly favors an open-and-above-board policy. The old day of "wink the other eye" and endeavor at the same time to maintain a reputation for honesty among the general public at large, has passed on with many other traditions of former days.

It is interesting to note that a large construction gang is now at work in the West upon a hydroelectric project, as detailed on another page of this issue, wherein the pernicious practices of the rake-off gang boss is wholly abandoned. The results are already perceptible in raising the standard of labor among such men.

Historians tell us that the three great ties that hold human beings together are community of race, community of religion and community of interest. Under the old regime the two former were maintained in the camps, but not until the common laborer can be impressed with the fact that he is getting a square deal is community of interest attainable. Thus, by maintaining separate camps for each nationality and by the laborer's enjoying the additional wage per day which formerly dropped into the gang boss's pocket, a result is accomplished in lessening the migratory movement of foreign help and in getting superior human effort during the hours of service.

Boiler Efficiency

There has arisen considerable misunderstanding as to the true meaning of boiler "efficiency." In Pacific Coast practice, due to the fact that a portion of the steam generated by burning fuel oil is utilized in atomizing the oil itself. some are prone to penalize the evaporating power of the boiler by deducting the heat equivalent of the steam as used.

As generally understood the "efficiency of boiler, furnace and grate" is the relation between the heat absorbed per pound of fuel fired, and the calorific or heating value of this pound of fuel. The "efficiency of boiler and furnace," on the other hand, is the relation between the heat absorbed per pound of combustible burned, and the calorific value of one pound of combustible. This latter expression of efficiency furnishes a means for comparing one boiler and furnace with another where the losses of unburned fuel due to grates and cleanings are eliminated.

We are told in the revised rules of the American Society of Mechanical Engineers for boiler testing that the "combustible burned" is determined by suptracting from the weight of coal supplied to the boiler, the moisture in the coal, the weight of ash, and the unburned coal withdrawn from the furnace and ashpit, and the weight of dust, soot, and refuse, if any, withdrawn from the tubes, flues and cumbustion chambers, including ash carried away in the gases, if any, determined from the analysis of coal and ash. The "combustible" thus used for determining the calorific value is the weight of coal, less the moisture and ash found by analysis.

As no specific rules are laid down by the national society for fuel oil burning, confusion has thus arisen. A strict interpretation of the efficiency of boiler and furnace would thus make it imperative that the heat equivalent of steam used in atomization be deducted. For many cases of comparison, however, such deduction is unjust because boilers operating with different burners, for instance, may require varying amounts of steam in atomization due to no fault in boiler design. Since such clouding of boiler efficiencies exists, the standards committee of the American Society of Mechanical Engineers would do well to be more specific, particularly for boiler tests using fuel oil.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

V. C. Gilpin, sales manager for the Braiduct Company, is at San Francisco.

John M. Klein of Mathias Klein & Sons of Chicago is at San Francisco.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Co., is at Seattle.

F. G. Baum, chief engineer with the Pacific Gas & Electric Company is making a brief trip East.

W. P. Sherman, engineer with the Platt Iron Works, is at San Francisco, making his headquarters with Chas. C. Moore & Company.

M. C. Lord, electrical engineer, Seattle, has the job of installing the electrical equipment for the Terminal Lumber and Shingle Company at Vancouver, B. C.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Co., has returned to the Eastern factory via Portland, after about a month's visit to the Pacific Coast.

R. W. Clark, formerly with the Minneapolis General Electric Company, has been made assistant manager of the Puget Sound Traction, Light and Power Company at Seattle.

F. H. Shepard, special representative of the Westinghouse Electric and Manufacturing Company, New York, spent several days during the week of March 9th in Seattle on general work of the company.

Arthur S. Merrill, sales representative of the Chicago Fuse Manufacturing Company, is visiting the Pacific Coast trade. He left California this week for Portland and Seattle.

C. V. Schneider of the Electric Supply Company at Sacramento, Cal., was at San Francisco during the past week and reported great enthusiasm for the Jovian Rejuvenation at Sacramento on March 29th.

J. C. Nowell, formerly plant manager of the Bell Telephone Company of Pennsylvania at Philadelphia, has been chosen general manager of the Pacific Telephone and Telegraph Company at San Francisco.

Frank H. Gale, manager of the advertising department of the General Electric Co., is at San Francisco, where he addressed the Electrical Development and Jovian League and the San Francisco Ad Club during the past week.

Albert Harris of the Harris Trust and Savings Bank, Chicago, and **A. B. Forbes** of Harris, Forbes & Co. of New York, heavy investors in electrical securities, have been in Seattle and other Northwest cities for some time sizing up conditions and looking over plants.

A. J. Kennedy, formerly manager of the incandescent lamp department of the Westinghouse Electric and Manufacturing Company's Los Angeles district office, has entered the firm of B. F. Kierulff Jr. & Co. as sales manager of the electrical equipment department.

C. E. White has joined the Pacific Coast sales organization of the Holophane Works and will devote most of his time to the Pacific Northwest. He is now giving a series of lectures before the members of the Electric Bond & Share Company's properties in Utah.

E. A. West, assistant engineer for the Portland Railway, Light and Power Company, has been elected chairman of the Portland branch of the National Electric Light Association, **R. S. Carroll,** assistant engineer line department of the Portland Railway, Light and Power Company, treasurer, and **C. B. Smith,** assistant engineer of the Pacific Power and Light Company, secretary.

M. H. Gerry Jr., president of the International Power and Manufacturing Company of Helena, Mont., **Robert Howes,** consulting engineer at Seattle, Wash., **James A. Lighthipe,** electrical engineer with the Southern California Edison Company at Los Angeles, Cal., **C. E. Magnusson,** professor of electrical engineering at the University of Washington, Seattle, Wash., **Wynn Meredith,** member of firm of Sanderson & Porter, San Francisco, Cal., and **Wm. S. Turner,** consulting engineer at Portland, Ore., have been transferred to the grade of fellow in the American Institute of Electrical Engineers.

Geo. J. Henry Jr., consulting engineer at San Francisco, has been appointed district sales agent for the Wm. B. Pollack Company of Youngstown, Ohio, for California, Oregon, New Mexico and Arizona, long established as one of the best and largest manufacturers in the United States of heavy steel constructions, including pipe lines for all purposes. Mr. Henry also represents the Mannesmannrohren works of Germany, and is supplying the high pressure pipes for the 60,000 kw. installation of the Pacific Light and Power Company, Los Angeles, at their Big Creek plants. This pipe is now being delivered at the power site.

Theodore N. Vail has been elected life member of the corporation of the Massachusetts Institute of Technology together with **William Endicott Jr.** and **Everett Morss,** of Boston. Mr. Vail is president of the American Telephone & Telegraph Company, which through him has just made the gift of $25,000 to maintain the electrical library given to Tech. in the summer. Mr. Endicott is a Boston banker, member of the firm of Kidder, Peabody & Company. His father is one of the life members, so that both will now be together in the councils. Mr. Morss is a well known business man who has been active in alumni work, and is president of the Simplex Electrical Company.

R. B. Barnard. salesman Westinghouse Electric and Manufacturing Company, at Butte, Mont., **L. H. Beebe,** salesman General Electric Company, Los Angeles, Cal., **C. E. Cleveland,** instructor in electrical department, Portland School of Trades, Portland, Ore., **J. P. Hart,** draftsman Portland, Eugene and Eastern Railway, Portland, Ore., **George S. Humphrey,** distribution engineer Utah Power and Light Company, Salt Lake City, Utah, **James A. Shepard,** electrical engineer Tucson Gas, Electric Light and Power Company, Tucson, Ariz., **S. E. H. Smith,** district manager Sunbeam Incandescent Lamp Company, Vancouver, B. C., **Herbert Speight,** electrician Granby Mines, Anyox, B. C.; **B. R. Trout,** switchboard operator, Great Falls Power Company, Great Falls, Mont., **H. L. Twaddle,** Second Lieutenant, Fort Wright, Spokane, Wash., **D. I. Walker,** chief operating engineer, Vancouver Island Power Company, Victoria, B. C., and **J. F. Wheelock,** operator Colgate Power House, Pacific Gas and Electric Company, Dobins, Cal., have been elected associates of the A. I. E. E.

L. J. Corbett, associate professor of electrical engineering at University of Idaho, Moscow, Idaho, **J. G. Deremer,** chief engineer United Light and Power Company, San Francisco, Cal., **W. K. Fruedenberger,** chief engineer Public Service and Railroad Commissions of Nevada, Carson City, Nev., **James M. Gaylord,** engineer United States Reclamation Service, Los Angeles, Cal., **F. W. Harris,** consulting engineer, Los Angeles, Cal., **John Coffee Hays,** president and consulting engineer Mt. Whitney Power and Electric Company, Visalia, Cal., **W. A. Hillebrand,** professor of electrical engineering Oregon Agricultural College, Corvallis, Ore., **Paul Lebenbaum,** electrical engineer Portland, Eugene and Eastern Railway Company, Portland, Ore., **Edgar A. Loew,** assistant professor of electrical engineering, University of Washington, Seattle, Wash., **T. L. Philips,** construction engineer Pacific Light and Power Corporation, Los Angeles, Cal., **I. A. Rosok,** chief electrician Bisbee Improvement Company, Bisbee, Arizona, and **Herbert S. Sands,** manager industrial and power division of Westinghouse Elec. & Mfg. Co., Denver, have been transferred to the grade of member in the American Institute of Electrical Engineers.

MEETING NOTICES.

Oregon Technical Club

The regular meeting of the Oregon Technical Club was held at the Portland Commercial Club, Tuesday noon, March 11th. Geo. Sailor of the N. E. L. A. was chairman. The speakers were Paul Lebenbaum, chief electrical engineer of the P. E. & E. Railway and K. A. Schaller of the railway department of the Westinghouse Electric & Manufacturing Company.

Mr. Lebenbaum gave a general talk on his company's electrification, stating that there would ultimately be 262 miles of road electrified, the trolley voltage being 1500 volts d.c. They buy power from the P. R., L. & P. Co. at 60,000 volts, three-phase, 60 cycle, and use transformers and motor-generator sets to obtain the 1500 volts d.c. On the first section between Portland and Eugene they will have six substations, approximately 22 miles between them. Mr. Schaller gave a general talk on the electrification of old and new railroads, describing briefly the various standard practices.

The "Home Warming" of the Oregon Technical Club was postponed from February 22d until March 8th. About 70 members enjoyed an informal meeting in their new quarters at 247½ Stark street. Good fellowship and sociability prevailed throughout the evening, which was devoted to smoking, story telling, impromptu speeches, followed by a Dutch lunch.

Tacoma Jovian Luncheon League.

The Tacoma Jovian Luncheon League at its luncheon given on March 5th, was addressed by Mr. Osborn of the Washington Water Power Company, Spokane. The subject up for consideration was proposed legislation before the Washington legislature to settle the question as to who shall pay for cluster lighting systems. Mr. Osborn took the ground that the city after constructing these systems should be allowed to charge the cost back to the property owners along the street, the city then maintaining the system. A. L. Thorn, superintendent of city lighting, also made a few remarks, taking a similar stand.

Seattle Jovian League.

The Seattle Jovian League was provided with a special salmon dinner by the management of the Rathskeller at its regular weekly luncheon on March 14th. The meeting was addressed by Captain Thomas Davies, port warden, on the volume of business coming in and going out over the wharves and piers of Seattle. Remarks were also made by G. F. Fay, manager of the Drummond Literage Company, who spoke on the recent enlargement of the Seattle Port Commission from three to five members by the legislature. He urged the co-operation of the Jovians in the election of the two additional members.

Seattle Section, A. I. E. E.

The March meeting of the Seattle Section of the American Institute of Electrical Engineers was held March 18th in the Good Roads building, on the University Campus, under the auspices of the Electrophysics Group. Prof. E. A. Loew read a paper on "The Oscillograph and Oscillograms," and a stereopticon exhibit of some recent oscilligrams taken in the laboratory was given by L. E. Curtis. The meeting then adjourned to the engineering laboratory for the inspection of the University oscillograph equipment and other apparatus and laboratories used for electrical testing and research work.

Electrical Development and Jovian League.

This week's meeting was immensely interesting, the entire session being devoted to an illustrated lecture, "The West as World-Beaters in Engineering, by Prof. Robert Sibley, of the Mechanical Engineering Department of the University of California, and editor of the Journal of Electricity. Among the subjects touched upon were several of the great government irrigation projects, Los Angeles' water supply system, Hetch Hetchy water supply, San Francisco's high-pressure fire protective system, and several of the great hydroelectric power projects, among them the Lake Spaulding plant of the Pacific Gas and Electric Co, and the Big Meadows project of the Great Western Power Company. Over seventy members attended the luncheon and listened with pleasure and interest to the address.

Portland Jovian Luncheon Club.

The Jovian Luncheon Club met for the second time in the Oregon Grill, on Thursday, March 13th. The chair was filled by C. P. Osborne, superintendent of power of the P. R., L. & P. Co. Before the speaker of the day delivered his address, Mr. Osborne called upon various members to answer the following questions:

What is a vacuum and how can you obtain one? A. S. Moody.

What is the difference between kw. and kw.h.? J. C. Hinkle.

What is meant by load factor? W. H. Lines.

What is meant by C^2R activity? E. D. Le Tourneau.

What is meant by wattless current? H. R. Wakeman.

What is meant by diversity factor? R. R. Rabley.

What is the purpose of a fuel economizer? G. Jett.

What is mean by the elastic limit of wire in a cable? E. D. Searing.

A motion was made and carried that the affairs of the Jovian Luncheon Club, in the future, should be in the hands of an executive committee of three members. The chairman or oldest member of the executive committee to be the member who becomes automatically the chairman. The chairman to hold office for a month. A new member to the executive committee to be elected each month by the club. This first executive committee elected was F. D. Weber, chairman; G. M. Baker, A. C. McMicken.

Marshall Dana, associate editor of "The Oregon Journal," then spoke on "Commission Government." Mr. Dana said in part: "Government must be under the eye of the public to be efficient. Destructive criticism is generally backed by gross ignorance. The only criticism that produces any good is constructive criticism and can only be made after deep study and by the careful investigation. Do not criticize public officials for their acts, but criticize yourself for allowing a system which makes it possible to allow a public official to be held up to public criticism. Commission government gives the people the opportunity to study their government as public officials have their actions constantly under 'the check' of the public. Portland needs 'organized co-operative selfishness' to attain 'civic perfection,' not 'disorganized selfishness.'"

The stunt for next week's luncheon will be a debate. The question to be debated is "Should Jovianism Uphold Woman's Suffrage?"

NEW CATALOGUES.

Bulletin No. 19 from the Century Electric Company illustrates and describes Invincible Split Phase Constant Speed Motors in a most attractive manner.

Pierson, Roeding & Company have issued a neat booklet containing valuable data on Western Washington Cedar Poles, Douglas Fir, Cross Arms and Eucalyptus Pins and Brackets, as well as other transmission material which they are prepared to furnish.

G. A. Wilbur, San Francisco representative of the Duncan Electric Manufacturing Company is distributing Bulletin No. 26 on Duncan Portable Test Watthour Meters for checking the accuracy of consumers' meters. These meters are manufactured in several types for either a.c. or d.c. use.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

STANDARD SPECIFICATIONS FOR WIRING BUILDINGS.

(Concluded.)

Example No. 7—For Concealed Knob and Tube Work in a flat building in the Overhead District having individual meters for the various tenants, and overhead service. (Where underground service is desired and a common basement or back porch is available for the location of a common meter board, the specifications for "Service," "Meter Board" and "Meters" as given in "Example No. 6," for apartment buildings, will apply to flat buildings).

Service:

Separate service outlets for each flat are to be run from each meter to and through the ..... side of the building, and sufficient wire left extended to provide easy connection of service drops.

Main Service Switches and Cutouts:

(87) A main service switch and enclosed fuse cutout of the proper size is to be furnished and installed on each of the above mentioned services at points shown on plans, same to be enclosed in wooden cabinets located within easy reach from the floor, thoroughly lined with asbestos and painted to comply with all rules and requirements. The doors of same are to be fitted with suitable spring latches and hinged at the top so as to be self-closing.

Meters:

(88) Standard General Electric Company's recording wattmeters arranged for side connection will be furnished and installed by the P. R. L. & P. Company for each of the above mentioned services. The contractor, however, is to do all the neecssary wiring about the meters and provide ample wire for connection to the meters. The meters are to be located at points shown on plans.

Lighting Feeders:

(89) From the meters 3-wire feeders are to be run direct to the branch cutout cabinets in each of the flats having more than 12-16 c.p. lamps or their equivalent.

(90) In those flats having 12-16 c.p. lamps or less, a 2-wire feeder is to be run direct from the meter to the lamp or switch outlets in such flats.

Cutout Cabinets:

Copy clauses (82) omitting reference to janitor's apartment. Copy clause (71).

Branch Circuits:

Copy clauses (48) and (49).

Switches:

Copy clause (55).

(91) The lamps in the entry and at the head of the stairs of the upper flats are to be controlled by a set of 3-way switches, one switch to be located at the foot of the stairs and the other at the head of the stairs.

(92) The porch lamps of the lower flats are to be controlled by flush push button switches located in the halls just inside the outer front door. The switches controlling porch lamps of the upper flats are to be located in the upper halls at the head of the stairs.

(93) The rear porch and the basement lamps are to be controlled by rotary switches located in the kitchen, as shown on plans.

(94) Lamps in the attic halls are to be controlled by a set of 3-way switches, one of these switches to be located at the foot of the stairs and the other at the head of the stairs.

Example No. 8—For Conduit Work in a Warehouse or Factory Building in the Overhead District, having underground service down pole.

Service: Copy clauses (72) to (76) inclusive.

Meters:

(95) Standard General Electric Company's recording wattmeters arranged for side connection, will be furnished and installed by the P. R. L. & P. Co., the wiring contractor, however, is to furnish and install at the point shown on plans, a suitable meter board and all necessary wiring on same to and from the meters.

Lighting Feeders:

(96) From the lighting meter on the meter board, a set of three (3) conductor feeders is to be run to the various branch cutout cabinets located on each of the floors at points shown on plans.

Power Feeders:

(97) From the power meter on the meter board above mentioned a feeder is to be run to the elevator motor at the foot of the elevator shaft in basement, and terminated in a switch cabinet made up of No. 12 sheet steel with doors of No. 10 sheet steel, fitted with suitable spring latches and hinged at the top so as to be self-closing. In this cabinet is to be mounted a proper switch and cutout and provision made for future connection of motor leads.

Cutout Cabinets:

(98) On each floor, from the first to the top inclusive, and at the points shown on plans, cutout cabinets are to be furnished and installed, same to be made up of No. 12 sheet steel, with doors of No. 10 sheet steel, fitted with suitable spring latches and hinged at the top so as to be self-closing. In these cabinets are to be mounted the necessary combination knife switch and plug cutout branch blocks.

Copy clause (71). Copy clauses (46) and (47).

Branch Circuits: Copy clauses (48) and (49).

Switches:

Copy clause (54).

(99) All ceiling outlets connected by curved lines to switch outlets, which are indicated thus "S" on plans, are to be controlled by rotary snap switches.

(100) A part of the lamps in the basement near the foot of the stairs are to be controlled by a rotary snap switch placed on the wall at the head of the stairs.

Example No. 9—For Concealed Knob and Tube Work or Open Work in a warehouse or factory building, in the Overhead District having overhead service.

Service:

(101) Service outlets are to be extended from the ..... side of the building at a point above the windows at the position shown on plans. From here the mains are to be run to the main service switch and cutout.

Main Service Switch and Cutout:

(102) At a point shown on plans, the wiring contractor is to furnish and install a main service switch and enclosed fuse cutout for the entire lighting system, same to be enclosed in a wooden cabinet thoroughly lined with asbestos and painted to comply with all requirements. The door of same is to be fitted with suitable spring latch and to be hinged at the top so as to be self-closing.

Copy clauses (75) and (76).

Lighting Feeders: Copy clause (96).

Meters: Copy clause (95).

Power Feeder: Copy clause (81).

Cutout Cabinets:

(103) On each floor, from the first to the top inclusive, and at the points shown on plans, wooden cutout cabinets are to be furnished and installed, same to be lined with

asbestos and painted to comply with all rules and requirements. The doors of same to be fitted with suitable spring latches and hinged at the top so as to be self-closing. The wiring contractor is to furnish and install the cabinets complete. The cabinets are to contain the necessary three-to-two wire combination knife switch and plug cutout branch blocks.

Copy clause (71). Copy clauses (46) and (47).

Branch Circuits: Copy clauses (48) and (49).

Switches: Copy clause (54). Copy clauses (99) and (100).

Example No. 10—For Concealed Knob and Tube Work in a Residence in the Overhead District, having an underground service down pole.

Service:

Copy clauses (72) and (74).

(104) From the main service switch the wiring contractor is to extend the service mains to the meter board located at point shown on plans.

Meter:

(105) A Standard General Electric Company's recording wattmeter arranged for side connection will be furnished and installed by the P. R. L. & P. Co., the wiring contractor, however, is to furnish and install at point shown on plans, a suitable meter board and all necessary wiring on same to and from the meter.

(106) From the meter the mains are to be run to the branch cutout cabinet at point shown on plans.

Cutout Cabinet:

(107) On the second floor, at point shown on plans, a wooden cutout cabinet is to be furnished and installed, same to be lined with asbestos and painted to comply with all rules and requirements. The door of same to be fitted with a suitable spring latch and hinged at the top so as to self-closing. The wiring contractor is to furnish and install the cabinet complete. The cabinet is to contain the necessary three-to-two wire plug cutout branch blocks.

Copy clause (71).

Branch Circuits: Copy clauses (48) and (49).

Switches:

(108) The lamp in the vestibule is to be controlled by one set of 3-way switches, one of these switches to be located on the outside of the front entrance and the other inside of the inner vestibule door, at the point shown on plans.

(109) The porch lamp is to be controlled in the same manner with switches located beside those of the above mentioned set.

(110) The lamp in the hall on the first floor is to be controlled by a set of 3-way switches, one to be located at the foot of the stairs and the other at the head of the stairs, at the point shown on plans.

(111) The lamp in the upper front hall is to be controlled in the same manner, with switches located beside those of the above mentioned set.

(112) The lamp on the back stairway is to be controlled by one set of 3-way switches, one to be located in the kitchen to the left of the entrance to the back stairway, and the other to be located at the head of the stairs at point shown on plans.

(113) All ceiling outlets are to be controlled by flush push button switches (face plates to match other hardware) with the exception of those in closets and pantries, which are to be controlled by rotary snap switches.

(114) The lamp at the foot of the basement stairs is to be controlled by a rotary snap switch placed at the head of the stairs.

Note:—Owing to the increasing use of electrically operated heating, cooking, cooling, and power appliances in the household, it is advisable in wiring first-class houses to provide connection for at least a few of the above mentioned articles. The P. R., L. & P. Co., will be glad to offer suggestions as to the best means of providing such connections upon request.

Example No. 11—For Concealed Knob and Tube Work in a Residence in the Overhead District, having an overhead service.

Service: Copy clause (101).

Main Service Switch and Cutout:

Copy clause (102). Copy clause (104).

Meter: Copy clauses (105) and (106).

Cutout Cabinet: Copy clause (107). Copy clause (71).

Branch Circuits: Copy clauses (48) and (49).

Switches: Copy clauses (108) to (114) inclusive.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

March 10.

J. H. Evans, who conducts a telephone exchange at Patterson, Stanislaus county, filed an application asking that his company and the Pacific Telephone & Telegraph Company be permitted to enter into an agreement for an interchange of telephone and telegraph business. The Pacific Telephone & Telegraph Company joined in the application.

The San Diego & Southeastern Railway Company applied for authority to issue $500,000 of bonds, the proceeds of which will be used to discharge existing indebtedness.

March 11.

A decision was rendered granting authority to the San Diego Consolidated Gas & Electric Company to issue $106,000 of 6 per cent debentures. The original application was for $500,000. The proceeds will be used to discharge indebtedness.

The Livermore Water & Power Company and W. A. Bissell applied for authority to sell their plant to the Pacific Gas & Electric Company for $142,000. The latter company asked for authority to issue 1400 shares of its common stock at 65, in part payment.

The Tulare County Power Company applied for authority to issue $50,000 of stock and use the proceeds in extending its line.

March 12.

The Petaluma Power & Water Company filed its answer to the complaint of the city of Petaluma, asking for specifications and particulars in which it failed to provide adequate service.

A decision was rendered granting the application of E. W. Crosby to sell and of the Reedley Telephone Company to purchase the Reedley telephone exchange plant. The Reedley Telephone Company was also granted authority to issue $11,000 of stock.

A decision was rendered granting the application of the Great Western Power Company for authority to issue $4,411,000 of bonds. The proceeds will be devoted to general improvement, extension and development of the company's facilities, including the Big Meadows dam and reservoir, which will be completed at a cost of approximately $1,607,635.

March 13.

A. A. Weber filed an amended application for a certificate of public convenience and necessity to operate a gas plant in Dinuba.

A decision was rendered granting authority to the Southern Sierras Power Company to purchase the Elsinore Electric Light & Power Company at Elsinore, for $7500.

March 14.

A decision was rendered reducing the gas rate in the city of Palo Alto from $1.50 per thousand to $1.20 per thousand feet. The Commission found that under the rate of $1.20 per thousand feet, the Palo Alto Gas Company would have a return in excess of 8 per cent on its investment.

INDUSTRIAL

HIGH TENSION OUTDOOR TRANSFORMERS.

Recently high-tension transformers of all capacities and for any commercial voltage have been designed by the General Electric Company for outdoor service to meet the demand for power by consumers along high-tension transmission lines, who realize the advantages of electricity for both power and light, but who do not require enough power to justify the expense of a substation.

High Tension Outdoor Transformers.

Power transformers, 100 to 500 k.v.a., for distributing potentials (2300-6000) and all transformers above 6000 volts up to 500 k.v.a., employ the straight two-legged core type construction. The core consists of two vertical legs connected together at the top and bottom by yokes, thus forming a rectangle. Cylindrical coils and insulation cylinders are placed concentrically over the two vertical legs of the core, the high-voltage winding being outside the low-voltage winding and separated therefrom by oil ducts and the above-mentioned insulating cylinders.

Power transformers for all voltages may be self-cooled or water-cooled. In self-cooled transformers, the heat arising from the losses in the transformer is dissipated into the surrounding air by providing a tank with sufficient external radiating surface to limit the temperature inside the transformer to a safe value. The tanks for these transformers are made from sheets of steel, corrugated under great pressure and electrically welded together. A base and rim are cast directly to the corrugation, the joint between them being an actual weld. This forms a rigid one-piece tank which, when supplied with a suitable cover and gasket, is readily adapted for outdoor operation.

The main difficulty, however, in designing high-voltage transformers for outdoor use is encountered in bringing the leads out of the tank. In transformers below 17,500 volts this is easily accomplished by bringing them out through porcelain bushings set in, or underneath, the rim around the top of the tank. For potentials above 17,500 volts this method is unsafe so the leads are brought straight out through openings in the cover and protected from the weather by a porcelain covering, built up of several petticoats.

In water-cooled transformers, the heat generated by the losses in the transformer is artificially extracted from the oil by circulating cold water through a seamless coil of pipe placed in the upper part of the tank and submerged in the oil. The expensive corrugated tanks for radiating the heat are, therefore, unnecessary, so a plain steel plate tank is provided. Transformers in these tanks are suitable for outdoor operation when equipped with porcelain petticoat leads brought out through metal bushing holders.

Transformers having a capacity greater than 500 k.v.a. are built of the shell type, i.e., the core surrounds the windings, which is in direct contrast to the core type, where the windings surround the core.

Self-cooled, small type transformers are not built in capacities much above 3000 k.v.a. because of the large and expensive tank construction necessary to obtain sufficient radiating surface. The extra radiating surface necessary for self-cooled transformers above 750 k.v.a. is obtained by compounding the corrugation; i. e., two plain corrugated sheets are welded together to form one large corrugation. This tank has about 65 per cent more radiating surface than the plain corrugated tank. Another type of tank for large capacity self-cooled transformers is known as the "tubular" or "pipe" tank. This consists of a boiler plate tank having the ends of a double row of vertical steel tubes welded into it at the top and bottom, this providing a natural circulation for the hot oil from the top to the bottom of the tank through these external pipes, where the heat is quickly dissipated. The majority of transformers above 1000 or 1500 k.v.a. are water-cooled.

The tanks for water-cooled transformers are made from heavy boiler plate, being round for single-phase transformers and elliptical for three-phase units. They are perfectly plain and smooth, having no corrugation or pipes, which are unnecessary in this type of transformer. All these various tanks are designed for outdoor use when furnished with a suitable cover, gasket and loads.

Three large water-cooled transformers, 2750 k.v.a. each, have recently been designed for outdoor operation on a 110,000 volt circuit. These are in successful operation at the present time. Some 1000 k.v.a. self-cooled transformers in tubular tanks are also in successful operation outdoors on a 110,000 volt circuit.

TRADE NOTES.

The Denio Fire Alarm Company have just signed a contract with the Portland Railway, Light and Power Company for the equipment of three buildings of their new car shops.

The Westinghouse Electric and Manufacturing Company has received an order from the Puget Sound Traction Light and Power Company for a 1000 k.v.a. water-cooled transformer for the Tacoma smelter sub-station and for two 1000 k.v.a. air-blast transformers for the same company to be used in Seattle.

The Kilbourne & Clark Manufacturing Company, at 307 First Avenue South, Seattle, has under way the construction of an up-to-date plant at Columbia street and Western avenue. A recent fire put the company out of commission for a time and in going over the situation it was thought best to seek a new location. More room was needed for a growing business, enough business being on hand at this time to run the plant for six months. The chief feature of the industry is the building of rotary converters for wireless telegraph work. Over ninety per cent of the ships outfitted on the Pacific Coast have been supplied from the Kilbourne & Clark works.

NEWS NOTES

NEW INCORPORATION.

PRINEVILLE, ORE.—The Deschutes Power Company has been incorporated as a combination of the Cove Power Company at Culver, Oregon, and the Prineville Light & Power Company of Prineville, Ore. The two towns have already been connected by a 50 mile transmission line.

ILLUMINATION.

CASHMERE, WASH.—The council passed a resolution for the installation of a lighting system.

PORT TOWNSEND, WASH.—The mayor vetoed the franchise of the Key City Light & Power Company.

NEWPORT, ORE.—The Yaquina Electric Company will enlarge its plant at Newport and install new machinery to the extent of $3500.

QUINCY, WASH.—An ordinance was introduced for a franchise for the Wenatchee Valley Gas & Electric Company for electric light and gas.

WENATCHEE, WASH.—Wilbur B. Fosbay, Portland, has applied for a franchise for an electric power plant and for a central steam heating plant.

HUNTINGTON, BEACH, CAL.—Bids will be received up to April 7th for furnishing municipal lights and municipal lighting for the city of Huntington Beach.

ALHAMBRA, CAL.—The board of trustees has awarded the contract for the improvement of Main, Garfield and Fair Oaks avenues to the Newberry-Bendheim Electric Company, for $20,456, with lighting system complete.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will furnish light in Pleasant Valley and Jenne station on the Gresham Electric Railway, if the improvement club will secure enough subscribers.

BAKERSFIELD, CAL.—The board of supervisors has authorized an advertisement for bids for the erection of an electric light system for the Randsburg public highway lighting district, the bids to be received up to April 10th.

NEW WESTMINSTER, B. C.—The council has decided to proceed at once with the establishment of a municipal gas plant. H. Pabst of Portland is the engineer engaged to prepare plans and specifications and to call for bids and supervise the installation. The estimate of cost is placed in the neighborhood of $20,000.

NEWPORT BEACH, CAL.—The city trustees have employed Engineer J. I. Seamans to make an appraisement of the local light plant, bonds for the purchase of which were voted last September. If the appraisal is satisfactory to the owner of the local plant, the city will purchase the same, otherwise the city will build a distributing system out of the general fund and buy its current from one of the big power companies.

OAKLAND, CAL.—Electric and gas rates for the present year will remain the same as the rates of 1912 under the ordinance passed by the city council last week. The rates for the first 10,000 cubic feet of gas will be 90c per 1000; from 10,000 to 20,000, 85c; from 20,000 to 50,000, 80c, and more than 50,000 cubic feet, 75c per 1000. The electric light rates are 7c a kw.-hr. for the first 100 kw.-hrs.; 100 to 250 kw.-hrs., 5c; 200 to 300 kw.-hrs., 4c, and more than 400 kw.-hrs., 3c.

GALLUP, N. M.—The new building of the Gallup Electric Light Company is under way, and in course of a few weeks will be ready to receive the new machinery which the company is installing. Mr. B. R. Ellis, who has recently become interested in the company, was in town completing arrangements for the installation of the machinery, and will return soon to make arrangements for extensive improvements to poles and lines for power purposes. Within 60 days it is expected that current will be available for power purposes.

TRANSMISSION.

REDLANDS, CAL.—Work will commence in April on the construction of the power plant which C. G. Baldwin commenced last year in Mill Creek canyon. The estimated cost is $500,000.

VISALIA, CAL.—The Tulare County Power Company is making arrangements for the increasing of the capacity of the plant at Tulare and for the erection of many additional miles of pole lines through the southern end of the county.

NELSON, B. C.—The Wanoto Development Company will expend $75,000 on construction of a power plant at the junction of the Salmon and Pend d' Oreille rivers, according to David Walmsley of Nelson, one of the directors of the company. Work will commence shortly on the plant, which will have an initial capacity of 2500 horsepower. It is planned to build a line to Sheep Creek to supply the mines of that camp. American capital is behind the project.

SPOKANE, WASH.—A prospectus for a $1,400,000 power plant to be erected at the Weeks power site on the Spokane River at Trent, has been laid before the commissioner of public utilities, C. H. Fassett, by George B. Dresher, who submits a general outline based on a survey and estimate of cost made by Daniel Mead, professor of electrical engineering at the University of Washington. It is the intention to get a movement for a municipal power plant started in Spokane.

ARTESIA, TEX.—The power plant of the Pecos Valley Gas & Electric Company has begun operations. This plant was built or the purpose of furnishing power for irrigation purposes in the desert land lying outside the artesian belt. Twenty miles of country lines are now in operation, to be utilized for pumping water for irrigation. During this summer an additional unit of equal size will be put in and lines are to be run to Yayton and Lakewood into the pumping districts adjacent to these places.

DOWNIEVILLE, CAL.—The Sierra Power Company has applied for a franchise to erect and maintain electric power lines in this county. The same company has made similar applications in Plumas, Butte, Shasta, Glenn, Tehama, Colusa, Yolo, Solano, Yuba, Sutter and other counties of Superior California. It is trying to finance its project and these franchises would give it something on which to work. Albert C. Agnew is the representative who made application for the franchises. The franchise is to be offered for sale to the highest bidder here on April 7th.

AUBURN, CAL.—Many carloads of steel material for towers for a power line are now being hauled from the Nevada street freight house to Nevada county at a point about eight miles above the Bear River bridge on the Auburn-Grass Valley road. The towers will be used to carry wire of a high tension power line which will extend down through Nevada county to the McCourtney crossing of Bear River, and thence westward across the plains, crossing the Sacramento River near Vernon, continuing down through the Sacramento Valley to some point on San Francisco Bay. The Pacific Gas & Electric Company is doing the work and will transfer the electric current for power from a powerhouse situated below Grass Valley, where the waste water from the mines will be used to generate the power and then sold to farmers lower down for irrigating purposes.

TRANSPORTATION.

BURLINGAME, CAL.—The Burlingame Railroad Company, which built and operates the new Easton car line, has applied for a franchise for an extension to the Burlingame station.

AUSTIN, TEX.—A. V. Cole of Brownsville, Texas, has been granted a concession by the government of the state of Tamaulipas, Mex., for the construction of an extensive system of electric street railway, in Matamoras as well as extension of lines to other towns in that section. Negotiations are pending for the transfer of the concession by Mr. Cole to a syndicate of St. Louis men.

SACRAMENTO, CAL.—Attorneys for the Pacific Gas & Electric Company have filed application with the city commission for permission to open up Third street and certain parts of I and J streets, so that heavier steel rails may be laid. The Oakland, Antioch & Eastern Railway will use the tracks of the Pacific Gas & Electric in this district and it is desired to lay rails, not only heavier than those now in use, but lay the tracks a greater distance apart. The matter was referred to Commissioner Wilder of the department of public works.

STOCKTON, CAL.—Superintendent J. J. Hooper of the Stockton Electric Railroad announces that work on the North Ophir street car line, which will connect with the main street line, will be started next month. "I have received the shipping receipts for the curves. The ties will come from Santa Cruz and the poles will come from this State also. We could have started on the overhead system before this if the poles had been on hand. I am now listing the wooden poles on Main street which are to be removed. Some time ago we adopted a policy of displacing the wooden poles with steel poles. We did this wherever possible through the business section."

SAN FRANCISCO, CAL.—Construction of the extension of the Geary street municipal railway down Market street probably will be postponed until after the referendum election April 22. A second conference was held in Mayor Rolph's office between the municipal authorities and representatives of the United Railroads, in which the latter made it plain that if the city attempted to begin work before the election the company would be compelled to secure an injunction. While no formal decision was reached by the city officials, they took the position that it might be well to wait until after the election in order to keep the matter out of the courts. The stand taken by the United Railroads is that the city has no right at present to construct the two blocks of track from Kearny to Sansome streets, in Market street, for the purpose of running the Geary street cars to the ferry. It is contended the company's franchise rights would be jeopardized if the city were permitted to lay the rails at this time. If the people vote in favor of the traffic agreement its terms will automatically go into effect, thus permitting joint use of the outer tracks in lower Market street by the Sutter street cars and those of the municipal railway, as well as exchange of transfers and the other important privileges embodied in the compromise.

TELEPHONE & TELGRAPH.

CENTRALIA, WASH.—The Pleasant View Telephone Company have petitioned for telephone franchise in east Lewis county.

KOSMOS, WASH.—The board of county commissioners granted a franchise to J. P. Bucher for a line from Kosmos to Morton.

CLARKSTON, WASH.—The Pacific Telephone & Telegraph Company will have surveyors at work at once for construction of the line between here and Asotin.

NEWPORT, WASH.—A committee of Deer Valley farmers petitioned the county commissioners for the right to construct a telephone line along the highway connecting with Newport.

ALAMEDA, CAL.—Sealed bids will be received by the Board of Electricity of Alameda, up to March 27th, for furnishing and installing a police telephone and flash light system for the city.

RIVERSIDE, CAL.—The Pacific States Telephone & Telegraph Company have applied to the city council for a franchise to operate in Riverside. The council will take the matter under advisement for a month, while the Pacific people negotiate for the purchase of the Home system.

SOUTH PASADENA, CAL.—Representatives of Pasadena Home Telephone Company have applied for a franchise to lay conduits for their telephone wires from bridge across Arroyo at the west city limits, along Pasadena avenue, Mission street and Fair Oaks avenue, to the north city limits of Columbia street, the conduits to be laid in parkways, and not in streets, most of which have been recently paved.

ALAMOGORDO, N. M.—A proposition is under consideration for the projected telephone line from Cloudcroft to Mathill. The line will be 20 miles long, and run down James canyon and connect the farms and ranches along the line. Negotiations are being made with the Mountain States Telephone & Telegraph Company to connect at Cloudcroft with long distance line. It is expected that organization, which is being formed for the purpose of financing the line, will be completed soon and arrangements made to begin work at once.

OAKLAND, CAL.—The city of Oakland has begun suit to forfeit the bond of the Bay Cities Home Telephone Company. The bond totals $100,000 and the bondsmen are J. S. Torrance, Thos. W. Phillips, Wm. Thomas, Mark L. Gerstle and P. E. C. Bowles. The action is based on the contention that the telephone company violated its franchise when it merged with the Pacific Telephone & Telegraph Company last March. The Home company operated under a franchise granted by the city council on January 15, 1906, and City Attorney Woolner maintains that the provisions of the franchise specifically provide for the forfeiture of the bond in the event the company merged with another.

WATERWORKS.

OLYMPIA, WASH.—Wilbur B. Foshay of Portland has applied for a franchise for an electric steam heating and water plants in Olympia.

SACRAMENTO, CAL.—City Engineer Givan is working on the plans and estimates called for by the city commission of the contemplated water mains extension for the annexed territory.

BRAWLEY, CAL.—No. 8 District Water Company has sold 13,000 shares of No. 8 stock and proceeds from 2000 shares, amounting to $20,000, are being used for improvement of the system.

MAYFIELD, CAL.—Sealed bids will be received up to April 7, for the laying of water mains together with necessary valves and fittings and the installation of fire hydrants with connecting pipes and fittings in the town.

SANTA MARIA, CAL.—The Santa Maria Water Works is now fully under control of the Domestic Water Company, and Engineers Haviland & Tibbetts have charge of the entire plant. It is proposed to improve the plant up to the full standard of the requirements of the city.

PERRIS, CAL.—This town will have a domestic water system in the near future. Frank A. Lathrop will be in charge of the work. He has designed a system, whereby town will have ample supply of water for domestic purposes. Wells will be put down and in all probability water will be distributed to consumers by gravity.